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Photometry of Variable AFGL Sources

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ABSTRACT

Results of infrared photometric observations of 63 AFGL sources over the past nine years is presented. Using these data together with previous measurements of these stars, we determine pulsation periods and mean photometric characteristics. These stars are found to lie midway between classical Mira variables and the Radio Luminous OH/IR stars in their period distribution and photometric properties. For the sample as a whole, there is no evidence for sudden or transient behavior such as a switch in pulsation mode. Rather, these stars show rapid, but continuous, evolution from shorter period Miras with weak mass loss to longer periods and larger mass loss rates. The carbon rich stars in our sample have the same period distribution as the oxygen rich stars. None of the carbon stars have periods as long as those of the very long period Radio Luminous OH/IR stars.

I. INTRODUCTION

The study of variable stars at visual wavelengths is by now a very mature subject that has made major contributions to our understanding of the nature and life cycle of stars. At infrared wavelengths, the amount of data on variable stars is scarce by comparison. This is particularly true for stars that are either extremely faint or invisible at optical wavelengths, but none-the-less bright at infrared wavelengths. Without extensive monitoring programs such as are undertaken at numerous observatories at optical wavelengths, it has been difficult for a large body of data on infrared variable stars to be amassed.

A fairly clear picture of the evolution of red giants from their entrance to the classical Mira phase to the termination of their life on the Asymptotic Giant branch is now emerging (Kwok 1989, Van der Veen 1988). As a 1-2.5 $M_\odot$ Pop I star enters the Mira phase, it has a relatively short period of about 300 to 400 days, a low mass loss rate, and a very thin circumstellar dust shell. At the other end of this evolutionary sequence the star has become either a Radio Luminous OH/IR star (RLOHIR) or an extreme carbon star with a long pulsation period (over 700 days for the RLHOIR stars), a high mass loss rate, and a thick circumstellar dust shell. Although stars in transition between these two phases of evolution have often been identified as the dusty Miras found in the 2μm sky survey and the AFGL catalog, there has never been a large enough statistical sample to determine their group properties and how they relate to the well studied classical Miras and the more exotic RLOHIR stars and extreme carbon stars.

In this paper we present the results of an extensive monitoring program at wavelengths from 1 to 20μm of a selection of stars chosen from the AFGL

survey. Pulsation periods and mean photometric properties are determined using our data, data from the literature, and previous studies of the AFGL catalog. These properties are then discussed in the context of the late stages of stellar evolution.

II. OBSERVATIONS

The observing list for our monitoring program was drawn up by selecting very red stars that showed signs of significant variability in three published sets of photometry of AFGL sources. These were Ney and Merrill (1980), Gehrz, Hackwell and Grasdalen (1980), and Rudy, Bosnell and Willner (1979). We also used unpublished Minnesota photometry taken after the completion of the work by Ney and Merrill. We tried to include all stars with L-N colors of 2.0 or greater that showed variability at L of greater than 0.3 mag. Many well known visual variable stars that are also in the AFGL catalog were not included due to the low amplitude of their variations at L or because their L-N color was less than 2.0.

The new observations were made at O'Brien Observatory, Mt Lemmon Observatory, and the Wyoming Infrared Observatory (WIRO). A bolometer photometer and standard dual beam chopping were employed and calibration was performed using the photometric standards in Gehrz, Hackwell and Jones (1974). At O'Brien Observatory the aperture size was 20", at Mt Lemmon Observatory the aperture size was 18" and at WIRO the aperture size was 5". Since slightly different photometric bandpasses in the 10μm band were used at WIRO, the WIRO photometry was transformed to the O'Brien/Mt Lemmon filter system. This filter system is described in Ney and Merrill as their system No. 01.

The results are listed in Table 1. The first column is the AFGL number and the second column is the Julian Day of the observations to which 240000 must be added. The next nine columns list the measured magnitudes. The last column indicates whether the data is based on observations taken at WIRO, MTLM, or O'Brien. Internal errors in the photometry were never larger than ±0.1 mag at all wavelengths.

III. ANALYSIS

To determine the characteristics of this set of variable stars, we have made a literature search for further infrared observations. Table 2 lists the stars from Table 1 that have additional photometry in the literature along with the source of the photometry. Not listed in Table 2 are the three AFGL studies (Ney and Merrill 1980, Gehrz et al. 1980, and Rudy et al. 1979), which contain the majority of the observations that predate this study. In addition to published photometry, unpublished photometry of several sources was kindly provided by Paul Harvey. These data were used by Harvey et al. (1974) in their study of OH/IR stars in the 2μm catalog (IRC Miras).

The combined data base contains over 7,000 individual observations. The time coverage and the number of observations varies considerably between stars. WX Psc (CIT 3, +10011), for example, was observed on 66 dates stretching back before 1966 while some stars have only recently been added to our monitoring list. Using this large data base, we have determined the periods for as many of the stars listed in Table 1 as possible. To determine if a given star had variations in its infrared brightness that were clearly periodic, we first used information from optical studies or previous infrared studies if available. In most all cases where previously determined periods

were available, the infrared variations were well fit by that period with only minor adjustments being necessary. The majority of stars in our sample have no previous period determinations. In several cases enough photometry was available over a single cycle of the period to determine an approximate period which could then be fine tuned using the rest of the observations. For the remaining stars with less extensive observations, a period search was performed by choosing a period and then visually inspecting the resulting lightcurve in the L filter (the most often observed filter) and qualitatively assessing the fit to a simple sine curve.

The results are given in Table 3 and plotted in Figure 1. A question mark after the value for the period in column four of Table 3 indicates that one data point in the light curve did not fit. A question mark alone indicates that the star was clearly variable and showed some indication of periodic behavior, but more than one data point was inconsistent with any period. The last column in Table 3 contains notes about each individual star. An NV indicates the star did not vary by more than ±0.1 mag rms in the L filter. A V indicates that the star was clearly variable, but either the amplitude was too small to clearly define a period or several data points were inconsistent with any period. An Irr indicates the star was variable, but the variations appeared to be largely random. Finally, an ID indicates there were insufficient data to make an determination of the characteristics of the variability of the star.

Table 4 lists the mean values for several photometric quantities for each star. These values were obtained by taking a simple average of the magnitudes in each filter for the entire data set for each star. In a few cases where the coverage was clearly biased toward one particular phase in the

light curve, the mean values in Table 4 were estimated from the light curve. The amplitude of the light curve at L is given in the second column and was estimated from the light curves in Figure 1.

It is difficult to make a quantitative estimate of the completeness of our sample of infrared variable stars. The three studies of the AFGL catalog were each responsible for one third of the sky, so the principle source of our sample is not biased to any particular part of the sky. If we assume that all of the stars in Table 1 have an identical luminosity of 10^4 $L_\odot$, typical of dusty Miras and OH/IR stars (a few stars in Table 1 clearly are much more luminous than this), an estimate of the spatial distribution of our sample in the solar neighborhood can be made. We find that the projected surface density in the plane of the galaxy for our sample occupies a wedge approximately 1.6 kpc on a side and spanning galactic longitude 15° to longitude 225°. The derived surface density is nearly uniform within this wedge, suggesting that the sample is not strongly biased in distance. Under these assumptions, the derived surface density of our sample of stars is roughly 35 kpc^{-2}, about one third the local surface density of optically bright Miras (Wood and Chan, 1977).

Notes on individual sources follow:

AFGL 157 (WX Psc, CIT 3, IRC +10011). This star is a well known Type II OH/IR star studied by Hyland et al. (1972) and Harvey et al. (1974). The entire photometric history of this star at 3.5μm is shown in Figure 2. WX Psc shows variations in the mean L magnitude over several pulsations cycles of about 0.5 magnitudes but has maintained a fairly steady pulsation period since the 1960's. There is some evidence in Figure 1 that the pulsation period has lengthened slightly over the last decade, but there is no evidence for erratic

behavior such as a mode switch or loss of periodicity.

AFGL 168. The photometric history of this star at 3.5μm is shown in Figure 2. As with AFGL 157, this star has maintained steady pulsation for nearly 20 years, although there appear to be significant fluctuations within a pulsation cycle.

AFGL 489 (V384 Per, CIT 5, +50096). Although listed in the variable star catalog (Kukarkin et al. 1969) at SRa, this carbon star has maintained a regular pulsation cycle in the infrared for the past 20 years (Figure 2).

AFGL 529 (IK Tau, NML Tau). This famous OH/IR star has decreased in average brightness at L by about 0.5 mag since the late 60's and shows some evidence for mildly erratic behavior in recent years (Figure 2).

AFGL 700 (NV Aur, +50137). Another OH/IR star studied by Hyland et al. (1972). This star has decreased in brightness slightly in recent years but has maintained a remarkably steady pulsation period (Figure 2).

AFGL 1381 (CW Leo, +10216). This very well studied extreme carbon star shows steady pulsation for the last 20 years (Figure 2).

AFGL 2071 (VX Sgr). This well known M supergiant and RLOHIR star has shown variations in its pulsation period in the past (Mayall, 1970), possibly related to switching between higher modes. Over the past twenty years, it has shown fairly regular pulsation characteristics at L.

AFGL 2205 (V437 Sct, OH 26.5 +0.6). This very long period RLOHIR star has the largest amplitude light curve at 3.5μm of any star in our sample. Recent theoretical dust shell models that take into account the pulsation of the underlying star (Suh, Jones and Bowen 1989) indicate that this star has a bolometric light curve with an amplitude of a factor of three! Despite the extreme nature of this star's mass loss rate (10^{-4} $M_{\odot}/yr^{-1}$), pulsation period

(1575 days) and amplitude (2.5 mag at L), it has maintained regular pulsation characteristics over the 3.5 cycles for which it has been observed (Figure 2).

AFGL 2417 (V1129 Cyg, +30374). This star is included in the study of oxygen rich Mira Variables by DeGioia-Eastwood et al. (1981) and is listed in the variable star catalog as having a period of 270.5 days. It is a carbon star and our data are best fit by a 625 day period and can not be fit by a 270.5 day period. The amplitude of the pulsation appears to have increased since the early 70's (Figure 2). Perhaps AFGL 2417 has undergone a mode switch in the 60's and is now settling down into a large amplitude pulsation at approximately twice its former period.

AFGL 3116 (R CrB, HR 5880). This star is the prototype of an entire class of stars of the same name. Although occasionally showing signs of periodicity in the infrared (Strecker 1975), R CrB shows no long term stability in its period (Figure 2).

IV. DISCUSSION

The majority of the stars in this study are carbon and oxygen rich red giants. Two M supergiants (VX Sgr and U Lac) and the peculiar star R CrB are the only stars in the study that are clearly not red giants, and of these only VX Sgr is clearly periodic. One of our main motivations for studying infrared variable stars is to investigate the properties of stars that might be in an evolutionary phase between the well studied optically identified classical Mira variables and the highly evolved and dusty RLOHIR stars and extreme carbon stars. The RLOHIR stars are often variable with periods ranging from 600 to 2000 days (Engles et al. 1983), have very high mass loss rates (up to 10^{-4} $M_\odot/yr^{-1}$) and are thought to be the final stage of evolution of a 1-9 $M_\odot$

star on the Asymptotic Giant Branch (Jones et al. 1983, Herman and Habing 1986, Van der Veen 1988, Kwok 1989).

Jones et al. (1983) speculated that the very long periods and high mass loss rates of the RLOHIR stars could be due to a switch from first overtone to fundamental mode as a red giant evolves up the AGB. In this scenario, classical Miras are pulsating in first overtone mode. As they age they slowly increase in luminosity, pulsation period, and mass loss rate and become moderately dusty Mira variables and develop weak Type II OH emission. At some point in their evolution their pulsation switches to fundamental mode with a resulting very long period and greatly enhanced mass loss. In this phase the star becomes a RLOHIR star with a thick circumstellar shell and significant OH maser emission detectible at large distances from the sun. Based on Figure 3 in Jones et al. (1983), we would expect this mode switch to take place at about 500 days for 1-2.5 $M_{\odot}$ stars.

This scenario has not received much support in the literature. Recent theoretical work (Bowen 1988) and analysis of observations (Bedijn 1988) suggests that although evolution is rapid towards the end of the classical Mira phase, there is no compelling evidence of a sudden transition such as a switch in pulsation mode. Rather, the star develops a thick circumstellar shell and an increase in pulsation period in a continuous manner. In this view the star is already pulsating in fundamental mode as a classical Mira. It is still possible, however, for the more massive semiregular variables and supergiants to undergo a mode switch, since they commonly display higher mode and multimode pulsation behavior (see Jones et al. 1987).

Optically identified Classical Mira variables have a well defined period distribution (Wood and Chan, 1977). Classical Miras have pulsation periods

ranging from 100 days to 500 days, with the vast majority within 100 days of a 300 day period. The period distribution for the flux limited sample from the AFGL catalog studied here is shown in Figure 3. Two facts are immediately apparent from Figure 3. The periods center around an average of 580 days, much longer than for classical Miras and there is no evidence for a gap in the period distribution indicative of a mode switch. The simplest interpretation of Figure 3 is that the AFGL variables are simply an extension of the normal Mira phenomena to longer periods and thicker dust shells. This is not unexpected; many previous investigations of dusty Mira variables but with far smaller statistics have reached similar conclusions (Hyland et al. 1972, Engels et al. 1983, Jones et al. 1983, Bedijn 1987). What is important is the lack of evidence for a sudden change in pulsation characteristics in this range of pulsation periods. If our sample is reasonably complete for the local solar neighborhood, a direct comparison with the observed period distribution of classical Miras shows our sample to be a smooth continuation of their period distribution to longer periods, with no gaps. Our results are in good agreement with the theoretical period distribution of Bedijn (1988) for the range in periods covered by our sample. Note that there is NO statistically significant difference between the period distribution of the carbon rich and the oxygen rich stars in our sample. Only one star, AFGL 2417, shows any signs of a mode switch in its pulsation period, and this conclusion depends on an old optical determination of its light curve.

The extent to which our sample of AFGL variables spans the lifetime between the classical Mira and RLOHIR stages of stellar evolution can be investigated using the infrared energy distribution of these stars. Figure 4 plots the K-L color as a function of the [8.6]-[10.7] color for those stars in

Table 1 that are NOT listed as carbon stars in the AFGL Catalog. The K-L color measures the change in the broad band energy distribution from 2 to 4μm. The [8.6]-[10.7] color index measures the contrast of the 10um silicate feature to the adjacent continuum. A normal red giant with no dust shell will have a K-L color of about 0.2 and a silicate color index close to zero, indicating no silicate emission above the photospheric flux due to a circumstellar dust shell. As dust is added around the red giant, its K-L color becomes redder (more positive) due to circumstellar reddening and to emission from the warm circumstellar dust, which is much greater in the L band than at K. The silicate dust in the shell emits strongly near 10μm creating a feature that goes into emission, causing the silicate color index to become increasingly positive. As the dust shell is thickened, the K-L color continues to redden monotonically while the silicate feature begins to self absorb, and finally goes into absorption, causing the silicate index to become smaller, then finally negative. Consequently, the silicate index is double valued, whereas the K-L color is not. This trend is illustrated by a solid line in Figure 4 which is taken from the theoretical dust shell models of Bedijn (1987).

Also plotted in Figure 4 are observations of classical Miras (DeGioia-Eastwood et al. 1981, Ney and Merrill 1980) and RLOHIR stars with known pulsation periods (Engels et al. 1983). Note that the oxygen rich AFGL variables completely fill in the gap between the classical Mira variables and the RLOHIR stars with some overlap with RLOHIR stars. The lone AFGL star (No. 2205) with a very red K-L color is the well known RLOHIR star OH 26.5 +0.6, which is bright enough to be included in the AFGL survey. The location of the AFGL variables in Figure 4 indicates they have moderately thick circumstellar shells but have not yet developed the deep silicate absorption feature so

common in the RLOHIR stars. The trend in Figure 4 could represent an evolutionary sequence from classical Mira to RLOHIR star (see van der Veen 1988, Jones et al. 1983), although it is unlikely a single star will traverse the entire diagram.

Figure 5 shows the K-L color as a function of pulsation period for the AFGL variables (both carbon and oxygen rich), classical Miras and RLOHIR stars. Again, the AFGL variables completely fill the gap between the classical Miras and the RLOHIR stars with some overlap with the RLOHIR stars. Although it is tempting to associate the pulsation period with evolution up the AGB in the sense of longer periods corresponding to longer time on the AGB, other factors are involved. The pulsation period is also a function of main sequence progenitor mass. Stars more massive than 1-2.5 $M_{\odot}$ stars (the main sequence progenitors of the classical Miras) will tend to have longer periods at any stage of their evolution as pulsators than lower mass stars (see Wood and Bessel 1983, Willson 1982). Consequently the clear trend in K-L color with pulsation period seen in Figure 5 should not be interpreted as entirely due to a single evolutionary sequence but rather as a combination of the trend to longer periods as a star evolves up the AGB in addition to the effects of having a range in main sequence progenitor mass, at least for the RLOHIR stars (see Fig. 3 in Jones et al. 1983, Fig 3 in Bedijn 1988).

Since the AFGL variables are mostly a relatively nearby sample dominated by old disk stars (section III) just as is the case for the classical Miras, the trend in K-L color from 300 days to 800 days is probably due primarily to an evolutionary sequence for 1-2.5 $M_{\odot}$ stars as they evolve up the AGB. Note that the change in K-L color with period is steepest for the AFGL variables, further adding credence to our supposition they represent a phase of rapid

transition from classical Miras to the more extreme very dusty stars. Since the number density of the AFGL variables in the solar neighborhood is less than the classical Miras (section III), but greater than the RLOHIR stars (Jones et al. 1983), an intermediate lifetime of about 10^5 years is indicated.

To our knowledge, no carbon stars have been found with periods as long as the very long period RLOHIR stars. The lack of carbon stars with the extremely long periods of the RLOHIR stars (the extreme carbon star CW Leo/IRC +10216 is in our AFGL sample) is puzzling, considering the complete overlap in the period distribution for the carbon rich and oxygen rich AFGL variables. Perhaps the carbon stars will completely loose their atmospheres by the time they reach a pulsation period of 800 days whereas the oxygen rich stars will continue to loose mass as they continue to evolve to longer periods. Alternatively, the very long period RLOHIR stars may represent a population with more massive main sequence progenitors that never become carbon stars. It is also possible that very long period carbon stars are very rare, as are the RLHOIR stars, but since they lack easily detectible maser emission, they have yet to be discovered. Perhaps the IRAS catalog contains several carbon rich counterparts to the RLOHIR stars that have not been identified.

Figure 6 shows the silicate color index as a function of pulsation period for the AFGL variables that are NOT carbon stars along with the classical Mira variables and RLOHIR stars. As in the previous two figures, the AFGL variables fill in the gap between the classical Mira variables and the RLOHIR stars. Note that the silicate feature alone is insufficient to distinguish between the less dusty classical Mira's and the AFGL variables. The location of the AFGL variables in Figures 4 and 6 indicates they have

circumstellar shells thick enough for self absorption in the silicate feature to be important, unlike the classical Mira's, which show only optically thin emission.

The amplitude of the AFGL variable stars in Tables 3 and 4 at L is significantly greater on average than the classical Mira variables (see Hyland et al. 1972 and Harvey et al. 1974) and range up to the large amplitude infrared light curves seen in some RLOHIR stars (Engels et al. 1983). Unlike visual colors, which are strongly influenced by the changing opacity in the photosphere of the star with pulsation phase, the L filter more closely follows the bolometric light curve of the star. Thus, as expected, longer periods are clearly associated with larger amplitude pulsation (see Engels et al. 1983). As with the infrared colors and period distribution, the infrared pulsation amplitudes of the AFGL variables occupy a position midway between those of the classical Miras and the RLOHIR stars.

V. CONCLUSIONS

Our sample is large enough that we can state with confidence that the dusty Mira variables found in the IRC catalog and the AFGL survey span the entire gap in period distribution and photometric behavior between the classical Mira variables and the more extreme RLOHIR stars. The fact that the period distribution of the AFGL variables shows no break or division into two groups argues that there is no sudden change in the pulsation characteristics of these stars as they evolve to longer periods and thicker dust shells. Although the evolution is rapid ($<10^5$ yrs), as evidenced by the rapid change in K-L color with increasing period around 600 days, it is probably continuous.

The lack of extreme carbon stars with periods as long as the very long period RLOHIR stars (>800d) is significant. The carbon stars in our sample have a period distribution identical to the oxygen rich stars, and show the same trend in K-L color with pulsation period. One might expect to find extreme carbon stars with very long periods similar to some of the RLOHIR stars. The simplest interpretation of our results is that up to a pulsation period of about 800 days, the pulsation and dust shell properties of carbon rich long period variables and oxygen rich long period variables are the same, excepting of course the composition of the dust. By 800d, either carbon stars have ceased their evolution as a red giant, perhaps due to complete dispersal of their atmospheres, or the very long period RLOHIR stars have main sequence progenitors that never become carbon stars, perhaps because they are more massive than the main sequence progenitors of the carbon stars. It is also possible that very long period carbon stars, which do not have the benefit of easily detectible maser emission, do exist, but have yet to be identified.

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TABLE 1

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
67	6793	--	--	5.4	2.2	0.6	-1.1	-1.6	-1.9	-2.4	WIRO
67	7039	--	--	4.1	1.2	-0.5	-2.0	-2.4	-2.5	--	OBR
67	7052	--	6.6	4.0	1.3	-0.2	-1.9	-2.2	-2.6	--	OBR
67	7106	--	--	4.6	1.4	0.0	-1.8	-1.9	-2.5	--	OBR
67	7132	--	--	4.5	1.7	0.1	-1.5	-1.9	-2.2	-2.8	OBR
67	7164	--	--	4.6	1.9	0.1	-1.6	-1.8	-2.4	-2.9	OBR
67	7298	--	--	5.6	2.5	0.9	-1.4	-1.5	-1.7	--	OBR
67	7410	--	--	5.4	2.4	0.7	-1.2	-1.5	-1.9	--	OBR
67	7466	--	--	--	2.3	0.6	-1.3	-1.8	-2.1	--	OBR
67	7499	--	--	4.7	2.0	0.2	-1.6	-1.8	-2.1	--	OBR
107	7052	--	5.0	3.5	2.0	1.4	-0.1	-0.7	--	--	OBR
107	7112	--	5.3	3.3	2.1	1.0	-0.3	-1.1	-1.1	--	OBR
107	7132	--	4.6	3.4	2.0	1.1	-0.2	-1.2	-1.6	--	OBR
107	7164	5.1	5.5	3.8	1.9	0.8	-0.6	-1.6	-3.6	--	OBR
107	7217	--	4.9	3.6	1.7	1.0	--	--	--	--	OBR
107	7298	5.2	3.8	2.5	1.4	0.6	-1.1	-1.9	-1.7	--	OBR
107	7383	--	4.3	3.0	1.8	1.1	-0.3	-1.2	-1.6	--	OBR
107	7410	--	4.6	3.3	2.1	1.6	-0.1	-1.0	-1.0	--	OBR
107	7499	--	4.8	3.5	2.3	1.2	-0.1	--	--	--	OBR
157	6003	--	--	3.4	0.8	-0.5	--	--	--	--	OBR
157	7052	--	3.8	1.6	-0.5	-1.7	-3.5	-3.9	-4.2	--	OBR
157	7147	6.2	4.4	2.1	-0.1	-1.6	-3.3	-3.7	-4.1	-5.1	OBR
157	7164	--	4.7	2.5	0.3	-1.2	-3.0	-3.3	-3.9	-4.9	OBR
157	7219	--	--	2.7	0.5	-0.9	-2.5	-2.9	-3.3	--	OBR
157	7364	--	5.6	3.2	0.4	-0.8	-2.2	-2.8	-3.2	--	OBR
157	7405	--	6.0	3.2	0.3	-0.9	-2.6	-3.0	-3.4	--	OBR
157	7466	--	4.8	2.3	-0.1	-1.4	-3.1	-3.4	-3.8	--	OBR
157	7499	5.8	4.2	2.2	-0.2	-1.7	-3.4	-3.8	-4.2	-5.5	OBR
168	6003	4.2	2.9	2.4	1.1	0.5	--	--	--	--	OBR
168	6021	4.1	2.9	2.1	1.2	0.5	-0.9	-1.8	-1.9	--	OBR
168	6785	4.5	3.4	2.5	1.6	1.0	-0.6	-1.3	-1.3	--	OBR
168	6793	--	--	2.6	1.6	1.0	-0.3	-1.0	-1.2	-2.0	WIRO
168	7039	4.4	3.3	2.4	1.3	0.5	-1.0	-1.7	-1.4	--	OBR
168	7060	4.1	3.2	2.2	1.3	0.4	-0.9	--	--	--	OBR
168	7112	4.0	2.9	2.1	1.5	0.6	--	--	--	--	OBR
168	7138	--	--	2.0	1.0	0.3	-1.2	-1.8	-1.7	--	MTLM
168	7147	4.1	2.8	1.9	1.0	-0.0	-1.3	-1.8	-2.2	-2.9	OBR
168	7164	4.2	2.9	2.1	1.4	0.4	-0.9	-1.5	-1.8	--	OBR
168	7219	--	--	2.0	1.1	0.2	-1.8	-1.8	-1.7	--	OBR
168	7304	4.1	3.2	2.2	1.1	0.6	-0.9	-1.7	-1.8	--	OBR
168	7364	--	--	--	1.9	1.7	0.0	--	--	--	OBR
168	7405	--	3.7	2.7	1.6	1.0	-0.8	-1.3	-1.4	--	OBR
168	7466	--	4.0	2.9	2.0	1.2	-0.5	-1.0	-1.2	--	OBR
168	7499	5.0	4.0	2.8	1.8	0.8	-0.4	-0.9	-1.2	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
230	7052	--	--	--	1.7	-0.2	-1.8	-1.2	-2.7	--	OBR
230	7119	--	--	5.8	1.9	-0.2	-1.7	-1.1	-2.7	-4.0	OBR
230	7132	--	--	6.2	1.9	-0.2	-1.5	-1.1	-2.6	-4.0	OBR
230	7164	--	--	--	2.2	-0.1	-1.6	-1.0	-2.8	--	OBR
230	7223	--	--	--	2.1	-0.2	-1.7	-1.1	-2.6	--	OBR
230	7304	--	--	--	2.0	0.3	-1.5	-0.8	-2.6	--	OBR
230	7399	--	--	--	2.5	0.7	-1.0	-0.3	-2.1	--	OBR
230	7419	--	--	--	2.4	0.7	--	--	--	--	OBR
230	7466	--	--	--	2.9	0.9	-0.5	-0.1	--	--	OBR
230	7503	--	--	--	3.1	0.8	-1.0	--	--	--	OBR
349	6785	--	4.7	3.1	1.5	0.4	-1.5	-2.2	-2.3	--	OBR
349	7119	4.8	3.7	2.2	0.7	-0.5	-2.2	-3.0	-2.9	-3.9	OBR
349	7132	5.0	3.5	2.1	0.6	-0.5	-2.2	-3.0	-3.1	-4.1	OBR
349	7164	--	3.7	2.7	1.1	-0.1	-1.9	-2.2	-2.2	--	OBR
349	7223	--	3.7	2.2	0.8	-0.4	-2.2	-2.9	-3.1	-3.8	OBR
349	7298	--	4.2	2.8	1.1	0.1	-1.8	-2.5	-2.6	--	OBR
349	7411	--	--	4.1	1.7	1.2	-0.3	-1.0	--	--	OBR
349	7466	--	4.4	2.9	1.3	0.3	-1.3	-2.1	-2.2	--	OBR
349	7503	5.9	4.2	2.6	1.1	-0.0	-1.8	-2.4	-2.7	-3.7	OBR
482	6785	--	7.0	4.3	1.4	-0.3	-1.7	-2.3	-2.5	--	OBR
482	6793	--	--	4.4	1.3	-0.5	-2.0	-2.3	-2.5	-3.0	WIRO
482	7147	--	--	--	2.8	0.7	-0.7	-1.6	-1.9	--	OBR
482	7164	--	--	--	3.6	1.1	-0.9	-1.1	-1.6	--	OBR
482	7223	--	--	--	2.0	0.1	-0.7	-1.2	-1.5	--	OBR
482	7289	--	--	4.5	1.4	-0.2	-2.0	-2.2	-2.6	--	OBR
482	7412	--	--	4.4	1.3	-0.2	-1.8	-2.2	-2.5	--	OBR
482	7466	--	--	4.7	2.0	0.4	-1.3	-1.6	-2.2	--	OBR
489	6690	--	--	1.5	-0.6	-1.6	-2.7	-3.3	-3.4	-3.5	WIRO
489	6713	--	--	1.4	-0.5	-1.3	-2.7	-3.2	-3.3	--	WIRO
489	6785	5.4	3.5	1.6	-0.3	-1.5	-2.7	-3.1	-3.2	--	OBR
489	6793	--	--	1.7	-0.2	-1.4	-2.7	-3.1	-3.2	-3.5	WIRO
489	7138	--	--	1.1	-0.8	-1.8	-2.9	-3.2	-3.4	--	MTLM
489	7147	4.7	2.8	1.1	-0.7	-2.0	-3.0	-3.4	-3.6	-3.7	OBR
489	7164	--	2.0	1.2	-0.4	-1.6	-2.5	-2.9	-3.2	-3.9	OBR
489	7187	--	2.8	0.9	-0.8	-1.9	-3.0	-3.3	-3.5	-3.5	OBR
489	7223	--	2.6	0.9	-0.8	-1.9	-2.9	-3.4	-3.5	-3.7	OBR
489	7298	--	3.1	1.3	-0.7	-1.8	-3.0	-3.3	-3.5	--	OBR
489	7411	--	--	2.1	-0.1	-1.1	-2.4	-2.8	-2.9	--	OBR
489	7466	--	4.8	2.4	0.4	-0.9	-2.2	-2.6	-2.8	--	OBR
489	7503	5.9	4.5	2.3	0.3	-1.1	-2.3	-2.8	-3.0	-3.7	OBR
490	6067	--	--	4.5	2.3	1.4	-1.1	-1.2	-1.6	-4.0	OBR
490	6690	--	--	5.3	2.9	1.7	0.1	-0.5	-1.1	-3.1	WIRO
490	6785	--	7.6	5.2	3.0	1.7	-0.2	-0.3	-1.1	--	OBR
490	6793	--	--	5.2	2.9	1.5	-0.2	-0.7	-1.3	-3.1	WIRO
490	7147	--	--	5.3	3.0	1.8	0.1	0.1	--	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
490	7187	--	--	5.5	3.2	1.8	-0.1	-0.4	-1.3	--	OBR
490	7223	--	--	--	3.2	2.0	0.4	0.1	-0.8	-2.2	OBR
490	7298	--	--	--	2.8	1.4	-0.1	-0.2	--	--	OBR
490	7412	--	--	--	2.9	1.5	-0.1	-0.4	-1.3	--	OBR
490	7439	10.1	8.0	5.5	2.6	1.6	--	--	--	--	OBR
490	7503	--	--	--	3.0	1.4	-0.0	-0.4	-1.3	--	OBR
527	6690	--	--	2.3	0.8	0.2	-1.0	-1.2	-1.3	-1.4	WIRO
527	6713	--	--	2.5	1.1	0.3	-0.7	-0.9	-0.9	--	WIRO
527	6785	4.9	3.3	1.9	0.8	-0.0	-1.2	-1.4	-1.4	--	OBR
527	6793	--	--	1.9	0.6	-0.1	-1.0	-1.2	-1.4	-1.6	WIRO
527	7138	--	--	2.0	0.6	-0.1	-1.2	-1.5	-1.5	--	MTLM
527	7147	5.3	3.4	1.9	0.7	-0.2	-1.1	-1.2	-1.7	--	OBR
527	7166	5.0	3.5	2.2	0.9	0.0	-1.1	-1.3	-1.4	-1.9	OBR
527	7223	5.5	3.7	2.2	1.0	0.1	-0.9	-0.8	-1.2	-1.8	OBR
527	7298	--	3.5	--	0.6	-0.1	-0.9	-1.4	-1.5	--	OBR
527	7411	--	--	2.1	0.5	-0.2	-1.2	-1.2	-1.1	--	OBR
527	7503	4.3	2.8	1.5	0.2	-0.6	-1.6	-1.7	-1.8	-2.2	OBR
529	6690	--	--	-0.2	-1.2	-2.3	-3.7	-4.3	-4.4	-5.4	WIRO
529	6713	--	--	-0.3	-1.6	-2.1	-3.8	-4.3	-4.0	--	WIRO
529	6748	2.7	0.8	-0.3	-1.5	-2.3	-3.8	--	-4.7	--	MTLM
529	6785	2.2	0.7	-0.4	-1.7	-2.5	-4.2	-4.6	-4.7	-5.6	OBR
529	7138	--	--	-0.3	-1.5	-2.3	-4.0	-4.6	-4.6	--	MTLM
529	7166	2.7	1.1	-0.1	-1.2	-2.1	-3.9	-4.5	-4.5	-5.6	OBR
529	7223	2.3	0.8	-0.4	-1.6	-2.5	-4.1	-4.6	-4.9	-5.8	OBR
529	7399	1.1	-0.2	-1.2	-2.3	-3.1	-4.6	-5.4	-5.5	--	OBR
529	7412	2.0	0.6	-0.4	-1.7	-2.6	-4.2	-4.9	-4.8	--	OBR
529	7503	1.4	0.0	-0.9	-2.0	-3.0	-4.6	-5.3	-5.3	-6.2	OBR
700	6138	9.4	4.6	2.8	0.8	-0.2	-2.0	-2.5	-2.8	--	OBR
700	6690	--	--	3.7	1.3	0.3	-1.2	-1.9	-2.1	-3.6	WIRO
700	6793	--	--	2.2	0.4	-0.6	-2.1	-2.8	-3.0	-4.2	WIRO
700	7164	--	5.2	3.5	1.8	0.6	-1.2	-1.7	-2.2	--	OBR
700	7187	--	5.1	3.1	1.3	0.2	-1.6	-2.1	-2.4	-3.8	OBR
700	7318	--	5.6	3.5	1.2	0.2	-1.3	-1.8	-2.2	--	OBR
700	7412	--	4.2	2.4	0.4	-0.5	-2.3	-3.0	-3.1	--	OBR
724	7166	4.5	3.6	2.7	1.6	0.9	-0.9	-1.7	-1.7	--	OBR
724	7187	4.4	3.6	2.5	1.4	0.6	-0.9	-1.8	-1.7	--	OBR
724	7318	3.6	2.6	1.9	0.7	0.2	-1.5	-2.3	-2.1	--	OBR
724	7412	3.0	2.0	1.3	0.3	-0.3	-2.0	-2.9	-2.8	--	OBR
796	6858	5.2	3.7	2.6	1.9	1.5	-0.2	0.4	0.5	--	OBR
796	7187	--	3.2	2.2	1.3	1.0	0.2	0.1	0.1	--	OBR
796	7223	4.8	3.4	2.2	1.3	1.0	0.1	-0.1	-0.2	--	OBR
796	7419	--	3.0	2.1	1.3	1.0	0.0	--	--	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
809	6024	--	--	5.3	2.2	0.5	-1.8	-2.4	-2.4	--	OBR
809	6156	--	--	4.7	1.9	0.3	-1.8	-2.1	-2.2	-2.6	OBR
809	6690	--	--	5.5	2.3	0.8	-1.2	-1.7	-1.9	-2.2	WIRO
809	6793	--	--	5.1	2.1	0.4	-1.5	-1.9	-2.1	-2.8	WIRO
809	7166	--	--	5.0	2.3	0.5	-1.5	-2.0	-2.4	-2.7	OBR
809	7304	--	--	--	2.5	1.2	-1.2	-1.7	-2.0	--	OBR
811	6690	--	--	0.5	-0.6	-1.3	-2.7	-3.8	-3.6	-4.5	WIRO
811	6793	--	--	1.0	-0.1	-0.9	-2.2	-3.1	-3.1	-4.0	WIRO
811	7187	3.0	1.7	0.8	-0.1	-1.0	-2.6	-3.5	-3.3	-4.2	OBR
811	7269	4.1	2.5	1.4	0.3	-0.4	-2.0	-3.0	-2.8	-3.4	OBR
811	7318	--	3.0	1.6	0.3	-0.1	-1.5	-2.4	-2.3	--	OBR
X 815	6027	--	6.4	4.8	3.2	1.6	0.5	0.1	-0.3	--	OBR
815	6748	--	4.9	3.2	1.5	0.6	-0.5	-0.8	-1.0	--	MTLM
815	6793	--	--	3.5	1.7	0.7	-0.3	-0.7	-0.8	-1.1	WIRO
815	7138	--	--	3.5	1.7	0.6	-0.4	-0.7	-0.9	--	MTLM
815	7166	--	5.0	3.5	1.9	0.6	-0.5	-1.0	-1.3	--	OBR
815	7269	--	4.6	3.2	1.6	0.5	-0.6	-1.1	-1.3	--	OBR
815	7412	--	--	4.0	2.2	1.1	-0.2	-0.5	--	--	OBR
842	7167	3.7	2.7	2.1	1.6	1.1	0.0	-0.9	-0.8	-1.7	OBR
850	6748	5.0	3.8	2.9	1.8	1.2	-0.5	-1.2	-1.2	--	MTLM
850	6793	--	--	2.7	1.3	0.6	-1.1	-1.5	-1.6	-2.3	WIRO
850	7167	5.2	4.0	3.1	2.0	1.3	-0.3	-1.0	-0.8	-1.6	OBR
850	7304	--	--	--	1.4	0.8	-0.9	-1.6	--	--	OBR
865	6024	--	--	--	2.2	0.3	-2.2	-2.7	-3.3	--	OBR
865	6027	--	--	6.6	2.2	0.0	-2.2	-3.0	-3.2	-3.3	OBR
865	6143	--	--	7.4	3.5	1.8	-1.2	-2.3	-2.5	--	OBR
865	6793	--	--	--	2.8	0.8	-1.7	-2.2	-2.5	-3.1	WIRO
865	7167	--	--	5.8	2.1	-0.2	-2.3	-2.8	-3.0	-3.2	OBR
921	6027	--	--	3.5	2.1	--	-0.8	-1.4	-1.1	--	OBR
921	6143	--	4.3	3.0	1.5	0.6	-1.4	-2.3	-2.2	--	OBR
921	6793	--	--	3.1	1.6	0.7	-0.9	-1.3	--	--	WIRO
921	7187	--	4.8	3.6	2.1	1.1	-0.7	-1.6	-1.5	--	OBR
954	6027	4.9	3.3	2.5	1.4	0.3	-1.1	-1.7	-2.1	--	OBR
954	6138	--	--	2.7	1.4	-0.2	-2.0	-2.5	-2.8	--	OBR
954	6793	--	--	3.1	1.8	1.0	-0.4	-0.9	-1.2	-1.5	WIRO
954	7167	--	4.7	3.5	1.9	0.7	-0.8	-1.3	-1.5	-1.7	OBR
954	7204	5.4	5.0	3.4	2.0	0.9	-0.8	-1.0	-1.1	--	OBR
999	7187	2.4	1.4	1.0	0.9	0.8	0.3	-0.2	--	--	OBR
999	7223	2.5	1.5	1.3	1.0	0.5	0.3	-0.2	-0.2	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
1074	6888	--	3.6	2.6	1.7	--	-0.9	-1.8	-1.5	--	OBR
1074	7187	4.9	3.6	2.7	2.1	1.1	-0.2	-0.5	--	--	OBR
1074	7223	4.8	3.5	2.7	1.8	1.0	-0.7	-1.4	-1.5	--	OBR
1085	7187	--	5.7	3.7	1.8	0.4	-1.1	-1.6	-1.7	--	OBR
1085	7223	--	--	3.7	1.7	0.3	-1.2	-1.6	-1.9	-2.7	OBR
1141	6748	3.9	2.6	1.8	0.8	-0.7	-1.4	-2.3	-2.2	--	MTLM
1141	6822	--	--	2.2	0.9	--	--	--	--	--	WIRO
1141	7204	4.3	3.1	2.2	1.1	0.1	-1.5	-2.4	-2.2	-2.9	OBR
1141	7280	3.8	2.6	1.8	0.9	0.3	-1.5	-2.2	-2.1	--	OBR
1274	6822	--	--	3.4	1.6	--	--	--	--	--	WIRO
1283	6110	5.0	3.9	3.2	1.9	1.4	-0.1	-1.5	-0.9	--	OBR
1283	7166	4.7	3.5	2.7	2.2	1.5	-0.2	-1.1	-0.8	--	OBR
1283	7204	4.6	3.6	2.5	1.9	1.1	-0.1	--	-1.2	-2.3	OBR
1283	7280	4.0	3.0	2.3	1.7	1.2	-0.5	-1.4	-1.1	--	OBR
1283	7318	4.0	3.2	2.3	1.6	1.4	-0.4	-1.2	--	--	OBR
1381	6110	--	3.4	0.1	-3.7	-5.8	-8.0	--	-8.7	--	OBR
1381	6783	6.6	3.3	0.1	-3.4	-5.4	-7.4	-7.9	-8.2	-8.5	OBR
1381	6858	--	4.2	0.7	-2.7	-5.4	-7.7	-8.0	-8.2	-8.7	OBR
1381	6888	--	3.4	0.2	-3.3	-5.3	-7.4	-7.8	-8.2	-8.2	OBR
1381	7166	--	5.2	1.9	-1.6	-4.0	-6.6	-7.1	-7.4	-7.9	OBR
1381	7204	--	4.8	1.7	-1.7	-4.0	-6.7	-7.2	-7.6	-7.6	OBR
1381	7280	--	4.2	1.1	-2.3	-4.2	-6.9	-7.4	-7.6	-7.9	OBR
1381	7318	--	3.3	0.4	-3.1	-4.8	-7.1	-7.6	--	--	OBR
1686	6124	5.6	3.9	2.9	2.0	2.2	-0.5	-1.5	-0.5	--	OBR
1686	6903	6.0	4.5	3.4	2.0	1.3	-0.3	-1.1	-1.4	--	OBR
1686	6924	5.9	4.4	3.2	2.0	1.3	-0.4	-1.2	-1.3	--	OBR
1686	6930	5.6	4.3	3.1	2.0	1.2	--	--	--	--	OBR
1686	6950	5.5	4.1	3.2	1.9	1.3	-0.3	-1.6	-1.8	--	OBR
1686	7269	--	4.8	3.5	2.4	1.7	0.3	-0.6	-1.0	--	OBR
1686	7280	4.0	5.5	3.7	2.5	1.9	0.3	--	--	--	OBR
1686	7318	--	5.0	3.7	2.4	1.7	--	--	--	--	OBR
1686	7372	--	--	2.7	2.2	2.0	0.1	-1.1	-0.9	--	OBR
1862	6133	5.1	4.0	3.0	2.0	1.6	0.0	-0.9	-0.1	--	OBR
1862	6824	--	--	--	1.3	--	--	--	--	--	WIRO
1862	6888	3.7	2.8	1.9	1.4	0.7	-0.6	-1.6	-1.5	--	OBR
1862	6907	--	--	2.1	1.2	0.7	-0.6	-1.4	-1.6	-2.4	WIRO
1862	6950	4.0	2.9	2.3	1.6	1.1	-0.5	-1.5	-1.3	--	OBR
1862	7269	--	--	2.6	1.6	0.8	-0.5	-1.2	-1.0	--	OBR
1862	7286	4.4	3.3	2.5	1.6	0.9	-0.4	-1.4	-1.2	--	OBR
1862	7305	4.0	3.1	2.4	1.5	0.7	-0.6	-1.5	-1.5	--	OBR
1862	7339	3.8	2.9	1.2	1.3	0.6	-0.7	-1.6	-1.6	--	OBR
1862	7348	3.7	2.7	2.1	1.2	0.5	-0.9	-1.9	-1.2	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
1862	7372	3.8	2.9	2.2	1.3	0.7	-1.1	-1.5	-1.2	--	OBR
1904	6888	3.3	2.2	1.5	1.1	0.7	0.1	-0.5	--	--	OBR
1904	6903	3.3	2.2	1.6	1.2	0.9	0.2	-0.2	-1.0	--	OBR
1904	6950	2.8	2.0	1.4	0.9	0.7	-0.1	-0.5	--	--	OBR
1904	7262	2.9	1.9	1.3	0.9	0.6	--	--	--	--	OBR
1904	7286	--	--	1.5	1.0	0.8	0.2	-0.2	--	--	OBR
1904	7342	3.0	2.2	1.4	1.1	0.6	0.1	-0.6	--	--	OBR
1904	7348	2.9	2.0	1.5	1.0	0.9	--	--	--	--	OBR
1904	7372	2.8	2.0	1.6	1.0	1.1	--	--	--	--	OBR
1977	6889	--	4.8	2.6	0.1	-1.3	-2.7	-3.2	-3.5	-3.7	OBR
1977	6903	--	4.1	2.8	0.1	-1.2	-2.7	-3.1	-3.3	--	OBR
1977	6950	--	4.9	2.6	0.1	-1.3	-2.8	-3.3	-3.4	-3.6	OBR
1977	7262	--	--	5.3	2.2	0.4	-1.5	-2.1	-2.5	-2.9	OBR
1977	7286	--	--	5.4	2.2	0.6	-1.5	-1.9	-2.4	--	OBR
1977	7339	--	--	4.1	0.8	-0.6	-2.2	-2.9	-2.9	--	OBR
1977	7372	--	5.9	3.6	0.6	-0.8	-2.7	-2.6	-2.9	--	OBR
2071	6950	1.5	0.5	-0.3	-1.4	-2.4	-3.9	-4.9	-4.9	-4.4	OBR
2071	7286	1.4	0.3	-0.5	-1.6	-2.6	-4.0	-4.9	-4.8	--	OBR
2071	7305	1.3	0.3	-0.4	-1.6	-2.3	--	-4.7	-4.8	--	OBR
2071	7348	1.5	0.4	-0.0	-1.5	-2.2	-3.9	-4.6	--	--	OBR
2071	7372	1.7	0.5	-0.1	-1.3	-1.9	-3.9	-4.4	-4.1	--	OBR
2162	6950	2.6	1.4	1.0	0.6	0.4	-1.0	-2.2	-2.2	--	OBR
2162	7017	2.6	1.5	1.0	0.5	0.4	-0.9	-2.1	-1.8	--	OBR
2162	7348	2.1	1.3	0.9	0.4	0.4	-1.2	-2.4	-1.9	--	OBR
2205	6164	--	--	7.1	1.5	-0.5	-1.9	-1.1	-3.3	--	OBR
2205	6403	--	--	--	1.3	-0.9	--	--	--	--	OBR
2205	6888	--	--	--	2.3	-0.4	-2.5	-0.8	-2.8	--	OBR
2205	6908	--	--	8.0	1.9	-0.3	-2.0	-2.0	-2.9	-4.3	WIRO
2205	6930	--	--	--	2.0	-0.2	-1.5	-0.6	-2.6	--	OBR
2205	6950	--	--	--	2.1	-0.2	-1.6	-1.0	-2.9	-3.7	OBR
2205	7017	--	--	--	2.1	0.2	-1.1	--	--	--	OBR
2205	7305	--	--	--	3.1	0.7	--	0.3	--	--	OBR
2205	7339	--	--	--	2.9	0.5	-0.8	--	--	--	OBR
2205	7379	--	--	--	3.4	1.4	0.4	--	--	--	OBR
2205	7405	--	--	--	3.0	1.1	-0.2	--	--	--	OBR
2206	6889	3.5	2.0	0.7	-0.5	-1.2	-2.8	-3.6	-3.4	--	OBR
2206	6950	3.9	2.3	1.1	-0.1	-0.8	-2.5	-3.2	-3.2	-3.5	OBR
2206	7017	5.5	2.7	1.3	-0.1	-0.6	-2.0	-2.9	-2.3	--	OBR
2206	7262	2.8	1.3	0.3	-0.8	-1.5	-3.0	-4.0	-3.9	-4.1	OBR
2206	7305	2.6	1.3	0.3	-1.0	-1.4	--	-3.3	-3.3	--	OBR
2206	7342	2.8	1.4	0.4	-0.6	-1.4	-3.0	-3.7	-3.6	--	OBR
2206	7379	3.2	1.6	0.5	-0.5	-1.0	-2.6	-3.6	-3.9	--	OBR
2206	7410	3.6	1.9	0.9	-0.2	-0.8	-2.6	-3.4	-2.9	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
2230	6192	4.3	3.2	--	--	--	0.5	-0.6	-0.9	--	OBR
2230	7305	4.0	2.8	2.2	1.6	1.6	--	--	--	--	OBR
2230	7348	--	--	2.2	1.5	1.7	-0.2	--	--	--	OBR
2232	6403	--	--	--	-0.5	-1.7	--	--	--	--	OBR
2232	6889	--	3.3	1.7	0.2	-1.0	-2.4	-2.9	-3.1	-2.8	OBR
2232	6909	--	--	1.8	0.0	-1.0	-2.5	-2.9	-3.0	-3.3	WIRO
2232	7017	4.9	3.0	1.4	-0.6	-1.4	-2.3	-3.0	-3.1	--	OBR
2232	7305	5.2	3.2	1.5	-0.5	-1.3	--	-2.5	-2.8	--	OBR
2232	7348	--	3.6	1.9	0.0	-0.9	-2.0	-2.6	--	--	OBR
2241	6890	3.4	2.0	1.3	0.5	-0.1	-1.8	-2.7	-2.5	--	OBR
2241	6909	--	--	1.4	0.5	-0.1	-1.5	-2.8	-2.6	-3.4	WIRO
2241	7017	3.9	2.4	1.5	0.6	0.4	-1.1	-1.2	-1.8	--	OBR
2241	7287	3.9	2.7	1.7	0.7	0.1	-1.3	-2.1	-1.9	--	OBR
2241	7342	3.3	2.2	1.4	0.6	-0.1	-1.6	-2.5	-2.5	--	OBR
2241	7379	3.2	2.1	1.2	0.4	-0.1	-1.6	-2.7	-2.6	--	OBR
2368	7025	--	3.9	2.0	-0.3	-1.2	-2.4	-3.0	--	--	OBR
2368	7305	--	--	3.4	0.9	-0.1	--	-1.6	-2.0	--	OBR
2368	7364	--	5.5	3.3	0.8	-0.3	-1.7	-2.5	-2.3	--	OBR
2392	7013	--	4.8	3.4	1.4	0.7	-0.3	-0.8	--	--	OBR
2392	7060	--	5.2	3.8	2.1	1.1	-0.2	-0.3	-0.8	--	OBR
2392	7348	2.1	1.7	1.8	2.2	2.1	--	--	--	--	OBR
2417	6909	--	--	2.9	0.7	-0.6	-2.1	-2.6	-2.7	-3.1	WIRO
2417	7017	5.3	3.7	1.9	-0.2	-1.0	-2.4	-3.0	-3.0	--	OBR
2417	7060	--	3.7	1.9	-0.0	-1.2	-2.4	-2.9	-2.9	--	OBR
2417	7355	--	4.3	3.5	1.3	0.1	--	--	--	--	OBR
2417	7364	--	6.0	3.8	1.5	0.5	-1.0	-1.6	-1.6	--	OBR
2417	7503	--	5.1	3.0	0.8	-0.6	-2.2	-2.5	-2.7	--	OBR
2440	6141	4.4	3.4	2.4	1.5	1.1	-0.5	-1.5	-0.9	--	OBR
2440	7025	--	5.3	3.7	1.9	1.3	0.3	-0.7	--	--	OBR
2440	7348	--	3.8	2.7	1.5	1.2	-0.4	-1.7	--	--	OBR
2443	7017	--	5.2	3.7	2.2	1.4	0.2	-0.2	--	--	OBR
2443	7060	--	5.4	3.6	2.1	1.3	0.2	0.3	--	--	OBR
2443	7106	--	4.7	3.3	2.1	1.1	-0.2	-0.4	-0.9	--	OBR
2443	7364	--	4.4	3.1	1.8	1.2	1.1	-0.1	--	--	OBR
2443	7503	5.4	5.1	3.6	2.1	1.3	0.6	-0.1	-0.2	--	OBR
2494	7017	--	--	4.7	1.2	-0.1	-2.0	-2.6	-2.5	--	OBR
2494	7108	--	--	4.5	1.7	-0.3	-2.4	-2.7	-3.0	-3.4	OBR
2494	7364	--	--	6.1	3.2	1.6	-0.6	-1.2	--	--	OBR
2494	7503	--	--	5.9	2.5	0.4	-1.8	-2.2	-2.6	-3.1	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
2511	6141	--	4.6	2.9	2.1	1.7	-0.2	-0.6	-0.7	--	OBR
2511	7025	5.3	3.8	2.9	2.1	1.3	0.7	-1.6	--	--	OBR
2511	7364	3.9	2.8	2.1	1.5	1.2	-0.3	-1.5	-1.2	--	OBR
2511	7410	--	2.9	2.2	1.6	1.3	-0.2	-1.5	--	--	OBR
2513	7025	--	--	4.8	1.8	0.5	-0.1	-1.0	--	--	OBR
2513	7108	--	--	5.2	2.0	0.4	-1.3	-1.5	-1.8	--	OBR
2513	7364	--	--	3.3	0.8	0.0	-1.6	-2.3	--	--	OBR
2513	7419	--	--	3.4	0.7	-0.3	-2.0	-2.3	-2.4	--	OBR
2513	7503	--	6.3	3.8	1.4	-0.1	-1.7	-2.1	-2.2	--	OBR
2617	6203	4.3	3.0	2.3	1.5	1.1	0.2	-0.9	-0.7	--	OBR
2617	6992	3.5	2.5	1.9	1.2	0.7	-0.4	-1.5	-1.4	--	OBR
2617	7048	3.8	2.7	2.1	1.3	0.9	-0.3	-1.3	-1.6	--	OBR
2617	7112	4.3	3.0	2.3	1.6	1.3	-0.1	-1.1	-1.1	--	OBR
2617	7379	3.7	2.8	2.1	1.3	1.0	-0.4	-1.7	-1.3	--	OBR
2617	7410	3.3	2.9	2.2	1.5	0.9	-0.3	-1.4	-1.2	--	OBR
2617	7503	3.7	2.6	2.1	1.4	0.9	-0.6	-1.6	-1.5	--	OBR
2686	6992	--	5.6	3.3	0.6	-0.6	-2.3	-2.5	-2.9	--	OBR
2686	7052	--	4.8	2.5	0.1	-1.2	-2.6	-2.9	-3.2	--	OBR
2686	7112	5.9	4.4	2.3	0.1	-1.3	-2.6	-2.9	-3.3	--	OBR
2686	7379	--	5.6	3.9	1.1	-0.1	-1.7	-2.3	-2.5	--	OBR
2686	7405	--	--	3.9	1.2	-0.1	-1.9	-2.3	-2.4	--	OBR
2686	7503	--	--	3.7	1.3	-0.4	-1.9	-2.3	-2.6	-3.0	OBR
2704	7025	--	5.8	3.8	1.5	0.2	-0.9	-1.5	-1.4	--	OBR
2704	7078	--	4.7	2.4	0.9	-0.5	-1.8	-2.0	-2.4	--	OBR
2704	7103	--	4.7	2.7	0.8	-0.6	-1.9	-1.5	--	--	OBR
2704	7223	--	4.5	2.6	0.6	-0.7	-1.8	-2.0	-2.4	--	OBR
2704	7379	--	5.8	3.6	1.4	0.5	-0.9	-1.5	-1.8	--	OBR
2704	7410	4.9	5.4	3.8	1.8	0.4	-0.9	-1.1	-1.7	--	OBR
2704	7412	--	--	--	1.4	0.2	--	--	--	--	OBR
2704	7419	--	--	3.6	1.4	0.5	-1.1	-1.3	-1.4	--	OBR
2704	7503	--	5.5	3.4	1.4	-0.1	-1.4	-1.4	-1.8	--	OBR
2771	7025	3.8	2.5	1.9	1.0	0.7	-0.2	-1.3	--	--	OBR
2771	7078	3.8	2.6	2.0	1.5	0.9	-0.6	-1.4	-1.0	--	OBR
2771	7103	3.9	2.7	2.1	1.5	0.8	-0.1	-0.9	-1.5	--	OBR
2771	7223	--	3.5	2.6	1.7	1.1	-0.1	-0.9	-1.0	--	OBR
2771	7383	--	2.9	2.1	1.2	0.8	-0.4	-1.5	-2.6	--	OBR
2771	7410	--	3.1	2.6	2.1	1.5	0.4	-0.7	-0.7	--	OBR
2771	7503	3.4	2.4	1.7	1.2	0.6	-0.7	-1.6	-1.5	--	OBR
2885	4885	--	--	4.6	1.1	-0.2	-1.4	-1.5	-2.6	-3.9	OBR
2885	7025	--	--	6.2	2.3	0.7	-1.0	--	-2.0	-3.1	WIRO
2885	7078	--	--	--	2.8	1.0	-0.8	-0.6	--	--	OBR
2885	7103	--	--	6.5	2.7	0.8	-0.1	-0.3	-1.7	--	OBR
2885	7399	--	--	--	2.9	1.1	0.0	--	--	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
2957	7044	3.0	2.2	1.7	1.2	0.7	-0.2	--	--	--	OBR
2957	7078	3.0	2.0	1.5	1.1	0.6	-0.8	-1.4	-1.2	--	OBR
2957	7103	2.9	2.1	1.8	1.3	0.8	-0.9	-1.1	--	--	OBR
2957	7223	--	1.9	1.6	0.9	-0.5	-0.7	-1.3	-1.4	--	OBR
2957	7383	3.1	2.1	1.6	0.9	0.6	-0.7	-1.8	-1.4	--	OBR
2957	7405	3.1	2.1	1.7	1.0	0.4	-0.8	-1.6	-1.2	--	OBR
2987	7044	4.3	2.9	2.2	1.3	0.7	-0.2	-0.3	--	--	OBR
2987	7078	--	2.7	2.0	1.4	0.7	-0.6	-1.5	--	--	OBR
2987	7103	4.1	2.9	2.0	1.3	0.6	-0.4	-1.4	-1 [illegible]	--	OBR
2987	7223	--	2.7	2.0	1.1	0.5	-0.6	-1.4	-1.5	--	OBR
2987	7383	--	3.0	2.2	1.1	0.9	-0.1	-1.2	-1.4	--	OBR
2987	7419	--	2.8	1.9	1.0	0.6	-0.4	-1.6	-1.6	--	OBR
3068	6027	--	--	--	4.5	1.8	-2.2	-2.8	-3.2	-4.0	OBR
3068	7405	--	--	--	3.2	0.7	-3.0	-3.8	-4.1	--	OBR
3099	7052	--	--	6.3	2.4	0.5	-1.8	-2.2	-2.5	--	OBR
3099	7103	--	--	6.0	2.3	0.1	-2.0	-2.5	-2.8	--	OBR
3099	7383	--	--	--	3.8	1.6	-1.0	-1.6	-2.1	--	OBR
3099	7410	--	--	--	3.2	-0.8	-0.9	-1.4	-1.5	--	OBR
3116	4159	9.0	6.2	3.7	0.8	--	--	--	--	--	OBR
3116	4164	--	--	--	0.9	-1.4	-2.8	-3.3	15.0	15.0	OBR
3116	6020	--	--	4.2	1.2	-0.8	-2.8	-3.2	-3.5	--	OBR
3116	7025	--	--	2.8	-0.3	-1.6	-3.4	-3.9	-4.0	-4.2	WIRO
3116	7048	--	5.6	3.0	-0.1	-1.6	-3.3	-3.8	-4.3	--	OBR
3116	7103	--	6.2	3.3	0.5	-1.4	-3.1	-4.0	-3.8	--	OBR
3116	7219	--	--	4.6	1.3	-0.6	-2.5	-3.1	-3.3	--	OBR
3116	7298	--	7.3	4.5	1.2	-0.7	-2.8	-3.1	-3.5	--	OBR
3116	7383	--	--	3.7	0.6	-1.0	-3.1	-3.6	-4.0	--	OBR
3116	7419	--	--	2.9	-0.2	-1.6	-3.6	-3.9	-4.1	--	OBR
3116	7503	--	5.1	2.5	-0.2	-2.0	-3.7	-4.1	-4.4	-4.6	OBR
3165	6003	--	--	3.0	1.4	0.5	--	--	--	--	OBR
3165	7052	--	3.8	2.5	1.1	0.3	-1.4	-2.0	-2.1	--	OBR
3165	7103	6.7	4.4	2.9	1.6	0.4	-1.0	-1.5	-1.7	--	OBR
3165	7223	--	4.5	3.1	1.4	0.4	-1.2	-1.4	-1.7	--	OBR
3165	7304	5.3	4.1	2.5	0.6	-0.2	-2.0	-2.6	-2.6	--	OBR
3165	7399	--	3.0	1.7	0.3	-0.6	-2.2	-2.8	-3.0	--	OBR
4173	6858	5.2	4.2	4.2	4.2	3.2	2.4	--	--	--	OBR
4173	6888	4.0	3.1	3.0	2.9	3.1	--	--	--	--	OBR
4173	6903	4.3	3.2	2.9	2.9	--	--	--	--	--	WIRO
4173	6907	--	--	3.0	2.8	3.1	2.6	2.8	--	1.7	WIRO
4173	6930	4.1	3.0	3.1	3.0	--	--	--	--	--	OBR
4173	6950	4.2	3.1	2.9	3.1	3.0	1.8	-0.0	--	--	OBR
4173	7269	3.9	3.0	2.9	2.8	3.1	--	--	--	--	OBR
4173	7280	4.0	3.3	3.0	3.1	--	--	--	--	--	OBR

AFGL	JD	J	H	K	L	M	8.6	10.7	12.2	18	Tel.
4173	7306	4.3	3.2	3.0	2.7	2.7	--	--	--	--	OBR
4173	7318	4.2	3.1	2.9	3.0	--	--	--	--	--	OBR
4219	6055	--	5.9	5.7	2.5	1.5	0.7	0.4	0.3	--	OBR
4219	6888	5.0	4.7	4.3	3.0	1.7	0.7	0.3	--	--	OBR
4219	6903	5.1	4.6	3.9	2.7	1.6	0.5	0.1	-0.1	--	WIRO
4219	6950	4.8	4.6	4.1	2.8	1.9	0.9	0.0	--	--	OBR
4219	7166	--	4.4	3.4	2.3	1.2	0.1	-0.2	-0.0	--	OBR
4219	7262	4.6	4.5	3.5	2.1	1.0	-0.2	-0.3	--	--	OBR
4219	7280	4.8	4.5	3.5	2.1	1.1	-0.2	-0.2	--	--	OBR
4219	7305	5.0	4.5	3.7	2.0	1.0	-0.1	-0.1	--	--	OBR
4219	7306	5.2	5.0	3.7	2.0	0.7	-0.0	--	--	--	OBR
4219	7339	--	4.9	4.2	2.3	1.3	0.4	--	--	--	OBR
4219	7348	4.9	4.7	3.7	2.1	1.0	-2.2	--	--	--	OBR
4219	7372	--	5.9	4.3	2.2	1.1	-0.4	-0.5	-0.7	--	OBR
4295	7044	5.7	3.9	3.7	2.8	2.7	0.8	--	--	--	OBR
4295	7103	5.6	4.2	3.4	2.6	1.7	0.1	-0.9	-0.8	--	OBR
4295	7383	--	3.2	2.5	1.5	0.9	-0.7	-2.1	-1.3	--	OBR
4295	7405	--	3.0	2.4	1.4	0.8	-1.1	-2.1	-1.8	--	OBR
5257	6888	--	4.5	2.6	1.3	1.0	-0.9	-1.8	-1.4	--	OBR
5257	7204	--	3.6	2.2	1.3	0.5	-1.2	-2.0	-1.7	-2.4	OBR
5615	6690	--	--	3.0	1.5	0.7	-0.8	-1.5	-1.8	-2.9	WIRO
5615	6990	5.4	3.9	2.9	1.4	0.8	-1.1	-2.0	-1.9	--	OBR
5615	7052	--	4.3	3.0	1.8	1.1	-0.7	-1.6	-1.4	--	OBR
5615	7078	6.4	4.3	3.2	2.0	1.3	-0.9	-1.6	-1.5	--	OBR
5615	7112	6.3	4.6	3.3	2.1	1.3	-0.4	-1.3	-1.2	--	OBR
5615	7223	--	5.7	5.3	1.8	1.0	-0.6	-1.2	-1.1	-1.0	OBR
5615	7379	4.9	3.4	2.3	1.0	0.4	-1.3	-2.4	-2.0	--	OBR
5615	7410	--	3.5	2.3	1.1	0.2	-1.4	-2.2	-2.2	--	OBR
5615	7503	4.6	3.3	2.1	1.1	0.2	-1.4	-2.3	-2.4	-3.4	OBR

TABLE 2
Sources of Additional Photometry

AFGL	Source
67	Lebofsky et al. 1978.
157	Ulrich et al. 1966; Hyland et al. 1972; Dyck, Lockwood and Capps 1974; Zappala et al. 1974; McCall and Hough 1980.
168	Dyck, Lockwood and Capps 1974; McCall and Hough 1980.
349	Ulrich et al. 1966; Dyck, Lockwood and Capps 1974.
482	Gehrz and Hackwell 1976; Joyce et al. 1977.
489	Ulrich et al. 1966; Wisniewski et al. 1967; Dyck, Lockwood and Capps 1974; McCall and Hough 1980; Noguchi et al. 1981.
529	Dyck, Capps and Lockwood 1974; McCall and Hough 1980
700	Harvey 1987; Hyland et al. 1972.
809	Lebofsky et al. 1978; Gosnell, Hudson and Puetter 1979.
815	Gosnell, Hudson and Puetter 1979; Noguchi et al. 1981.
865	Low et al. 1976.
1381	Becklin et al. 1979; Toombs et al. 1972; McCall and Hough 1980.
1686	Lebofsky et al. 1978.
1862	Dyck, Lockwood and Capps 1974; Hyland et al. 1972.
2071	Lee 1970; Humphreys, Strecker and Ney 1972; Humphreys and Lockwood 1972; Hyland et al. 1972.
2205	Low et al. 1976; Evans and Beckwith 1977; Engels, 1982; Werner et al. 1980; Willems and de Jong 1982.
2232	Noguchi et al 1981.
2417	Noguchi et al 1981.
2494	Low et al., 1976; Joyce et al. 1977.
2704	Dyck, Locwood and Capps 1974; Noguchi et al 1981.
2855	Joyce et al. 1977.
3068	Joyce et al. 1977; Lebofsky and Rieke 1977.
4219	Strecker 1975.
4295	Dyck, Lockwood and Capps 1974; Gosnell, Hudson and Puetter 1979.
5615s	Hyland et al. 1972.

TABLE 3

Periods

AFGL	Other Names	Sp T	Period	JDo	Notes
67		-	650	358	
107	V524 Cas, +70012	S	370	167	OH/IR
157	WX Psc, CIT 3, +10011	M10	645	0	
168	+30021	M9	555	389	
230	DO 24582	M0	-	-	Irr.
349	CIT 4, +60092	M8	534	-10	
482		C	567	2680	
489	V384 Per, CIT 5, +50096	SRa, C	540	70	
490		-	-	-	NV?
527	N414 Per, +40070	C	515	155	
529	IK Tau, NML Tau	M8e	460	780	OH/IR
700	NV Aur, +50137	M10	623	490	OH/IR
724	+60154	M9	-	-	V, but ID
796	SVS 6396, -10095	C	-	-	V?
809		C	780	0	
811	+70066	M9.5	?	-	V
815	+40140	C	517	895	
842	LO Aur, +50154	M9III	-	-	ID
850	+40149	M9	590?	1980	see Fig 4
865		C	686	250	
921	+00102	M10	580	1430	
954		C	?	-	V
999	DY CMa, -10138	M7	-	-	ID
1074	-10151	M8	-	-	V?, ID
1085		C	-	-	ID
1141	+30187	M9.5	582	255	
1274		M7ep	-	-	ID
1283		M9	-	-	NV
1381	CW Leo, +10216	C6	628	1630	
1686	OH 334.7 +50.0	M9III	?	-	700?, RLOHIR
1862	V697 Her, +30292	M9	445	80	
1904	-10358	M6e	-	-	NV
1977	DO 16032, +20326	M2	520	-6800	
2071	VX Sgr, -20431	M4-8e Ia	690	130	OH/IR
2162	UY Sct, -10422	M4Ia	-	-	ID
2205	V437 Sct, OH 26.5 +0.6	M	1575	1450	RLOHIR
2206	V1111 Oph, +10365	M9e III	500	6650	
2230		M7 III	-	-	NV
2232	+20370	Ce	511?	1930	see Fig. 4
2241	+10374	M8 III	590	250	
2368	-10502	Ce	-	-	V, ID
2417	V1129 Cyg, +30374	C	625	1950	see text
2440	+00450	M9	440	1360	
2443	IN Cyg, +30385	M6.5 III	-	-	NV
2494		C	783	500	

AFGL	Other Names	Sp T	Period	JDo	Notes
2511	+10451	M9	450	400	
2513		C	550	1720	
2617	+40435	M9	450?	1850	see Fig. 4
2686		C1	750	6900	ID?
2704	V1549 Cyg, +50357	Ce	533	0	
2771	-70171	M5	-	-	Irr?
2885		M?	?	-	1620?
2957	U Lac, +50446	M4 Iab	-	-	NV?
2987	MY Cep, +60375	M7	-	-	NV
3068		C	520?	3050	Irr?
3099		C	-	-	ID
3116	+40540	M8	620	1210	
3165	+60427	M9	419	150	
4173	DO 3372	M4	-	-	NV
4219	R CrB, HR 5880	Fpep	-	-	Irr.
4295	+10525	M9.5	505	1120	
5257	-20188	M9	-	-	ID
5615s	+40483	M9	605	650	

TABLE 4

Mean Values

AFGL	ΔL	L	K-L	L-[10.7]	[8.6]-[10.7]
67	1.6	1.9	2.82	3.79	0.29
107	0.8	1.9	1.61	3.22	0.95
157	1.4	-.1	2.56	3.06	0.57
168	0.8	1.6	1.07	3.00	0.79
230	-	2.3	4.10	3.64	-.53
349	1.5	1.0	1.59	3.48	0.79
482	1.9	2.1	2.82	3.84	0.40
489	1.0	-.4	1.95	2.73	0.48
527	0.7	0.7	1.63	1.99	0.21
529	0.9	-1.8	1.11	3.02	0.77
700	1.4	0.7	2.10	3.35	0.71
724	-	1.0	1.10	2.33	0.85
796	-	1.5	0.83	1.43	-.11
809	0.8	2.0	2.72	3.94	0.46
811	-	-.2	1.14	2.05	0.90
815	0.8	1.9	1.67	2.56	0.45
842	-	1.6	0.50	1.60	0.90
850	0.9?	1.7	1.05	2.87	0.75
865	1.4	2.9	4.06	5.25	0.59
921	0.7	1.9	1.31	3.45	0.81
954	-	1.8	1.52	2.63	0.51
999	-	1.0	0.20	0.65	0.50
1074	-	1.9	0.80	2.47	0.63
1085	-	1.8	1.95	2.90	0.45
1141	1.3	1.1	1.08	2.95	0.90
1283	-	2.0	0.76	1.85	1.19
1381	1.9	-2.7	3.72	4.75	0.58
1686	-	2.1	1.15	3.08	1.04
1862	0.9	1.7	0.97	2.90	0.93
1904	-	1.0	0.45	0.93	0.50
1977	2.0	0.9	2.90	3.60	0.43
2071	1.0	-1.4	1.30	3.27	1.10
2162	-	0.5	0.47	1.53	1.20
2205	2.5	2.1	6.34	3.48	-.30
2206	0.8	-.5	1.16	2.97	0.83
2230	-	1.6	0.70	1.35	1.26
2232	1.4?	-.2	2.16	2.87	0.56
2241	0.9	0.8	0.94	3.00	0.98
2368	-	0.5	2.43	2.52	0.32
2417	1.5	0.4	2.08	3.08	0.50
2440	0.9	1.6	1.28	2.87	1.04
2443	1.9	2.1	1.40	1.68	0.48
2494	-	2.2	3.15	4.47	0.63
2511	1.0	1.6	0.86	3.03	1.24

AFGL	ΔL	L	K-L	L-[10.7]	[8.6]-[10.7]
2513	1.2	1.2	2.69	3.28	0.40
2617	0.4?	1.4	0.80	2.69	1.04
2686	1.2	0.8	2.50	3.30	0.40
2704	1.3	1.0	2.11	2.77	0.32
2771	-	1.5	0.69	1.70	0.94
2885	-	2.0	3.39	3.14	0.08
2957	-	1.1	0.58	1.75	0.76
2987	-	1.2	0.84	1.60	1.00
3068	-	4.2	7.34	7.43	0.71
3099	-	2.9	3.23	4.35	0.56
3116	1.5	0.3	2.61	3.89	0.52
3165	1.1	1.0	1.40	3.09	0.69
4173	-	3.1	0.04	0.78	0.87
4219	-	2.4	1.92	2.44	0.22
4295	1.6	1.8	1.01	3.33	1.21
5257	-	1.3	1.10	2.35	0.85
5615s	0.9	1.5	1.54	3.29	0.87

FIGURE CAPTIONS

Fig. 1. Light curves for those stars in Table 1 with well determined periods (no question mark) or suggested periods (question mark) in the L (3.5μm) filter. The open symbols are the three most recent observations.

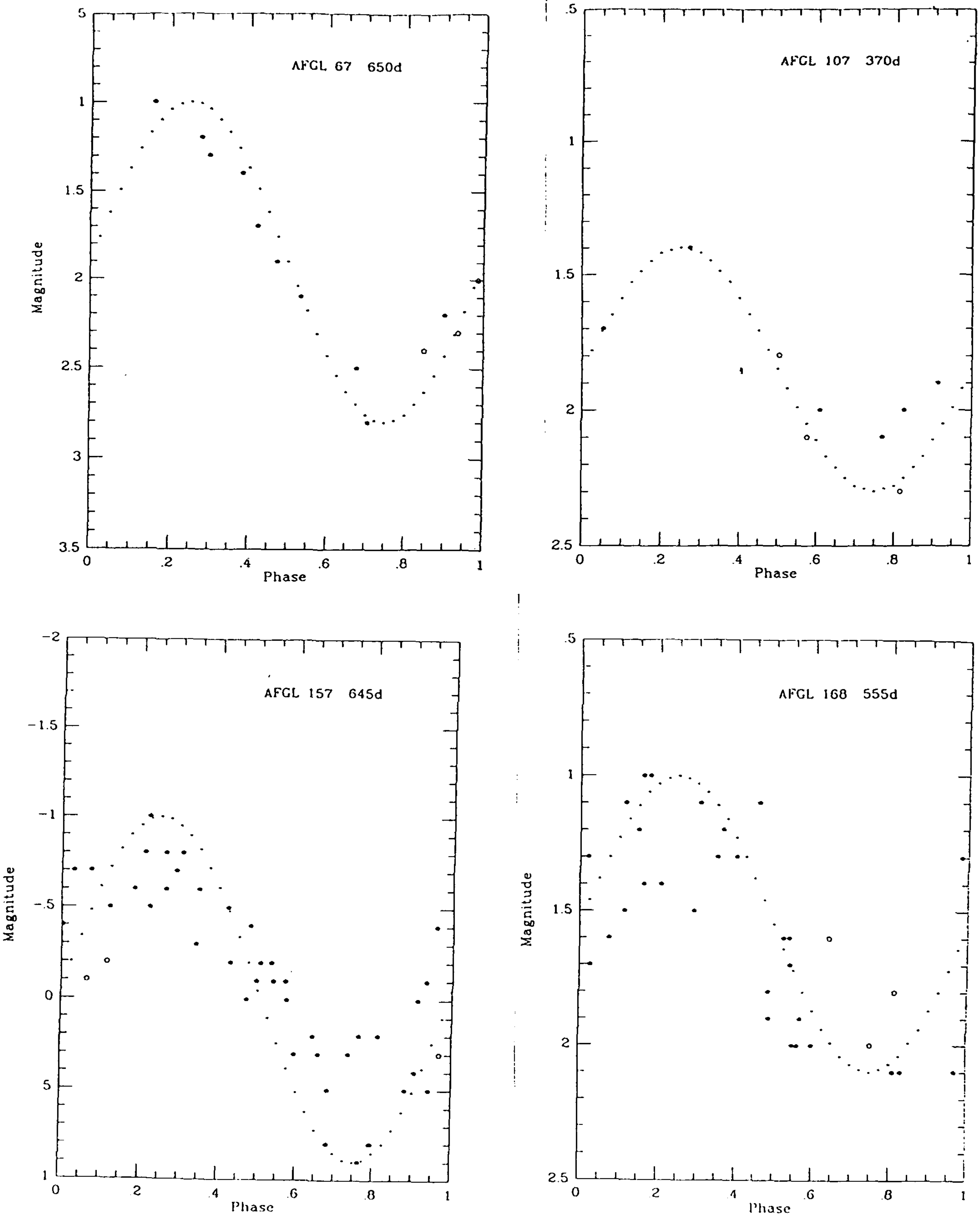
Fig. 2. Photometric history of selected stars in the L filter (see section III).

Fig. 3. A Histogram showing the distribution of the pulsation periods of the stars in Table 3 with periods.

Fig. 4. A plot of the mean K-L color against the mean [8.6]-[10.7] color for those stars in Table 3 with periods and oxygen rich photospheres. The [8.6]-[10.7] color is a measure of the strength of the well known 10μm silicate feature. Classical Mira variables are plotted as open circles. Radio Luminous OH/IR stars are plotted as open triangles. The solid line is the expected trend in these phtometric colors taken from the theoretical dust shell models of Bedijn (1987).

Fig. 5. A plot of the mean K-L color against pulsation period for all stars in Table 3 with periods. The symbols are the same as in Fig. 4.

Fig. 6. A plot of the mean [8.6]-[10.7] color against pulsation period for the stars in Figure 4. The symbols are the same as in Fig. 4.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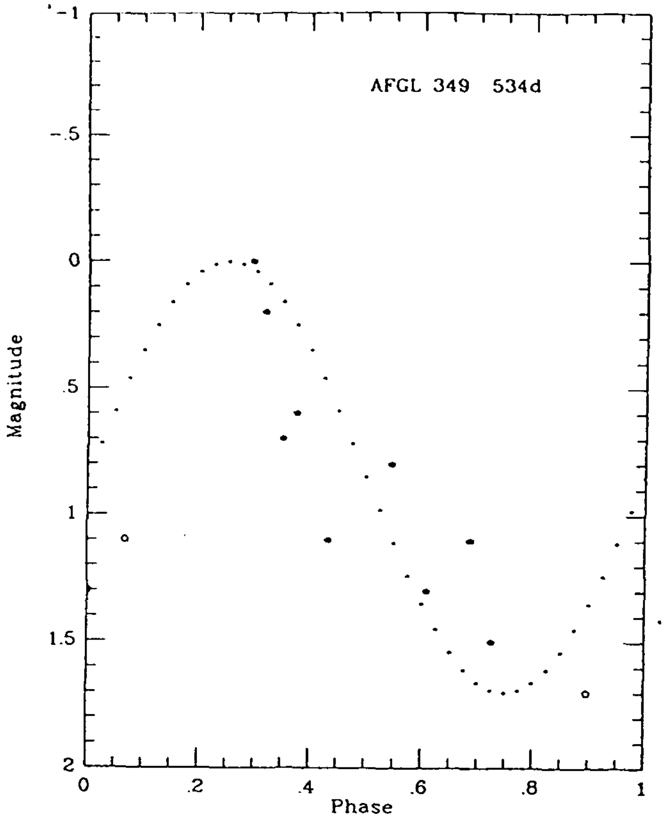
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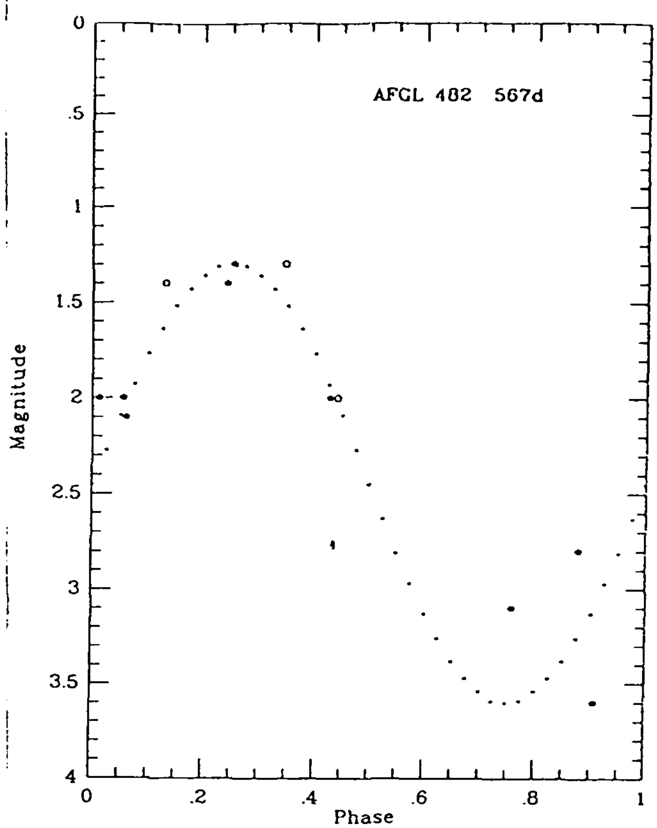
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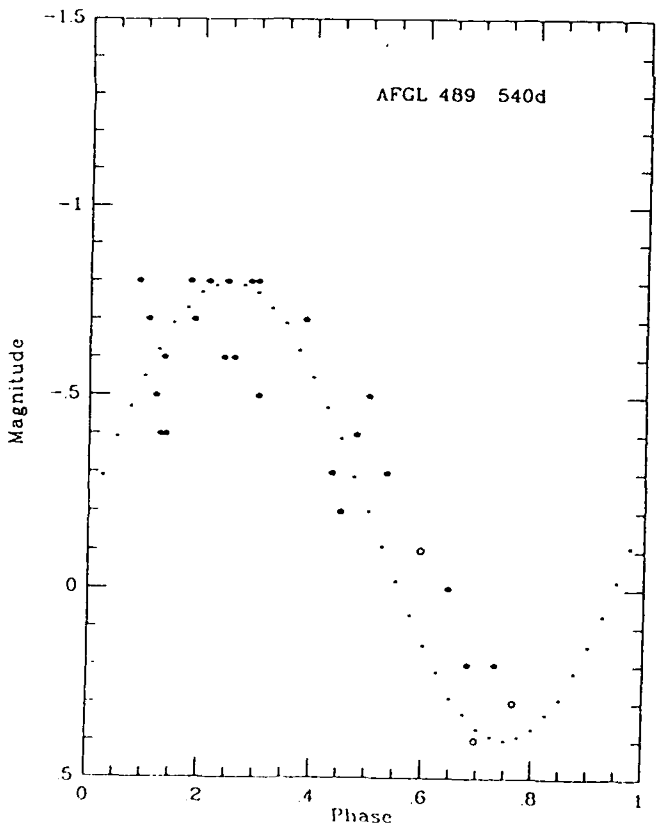
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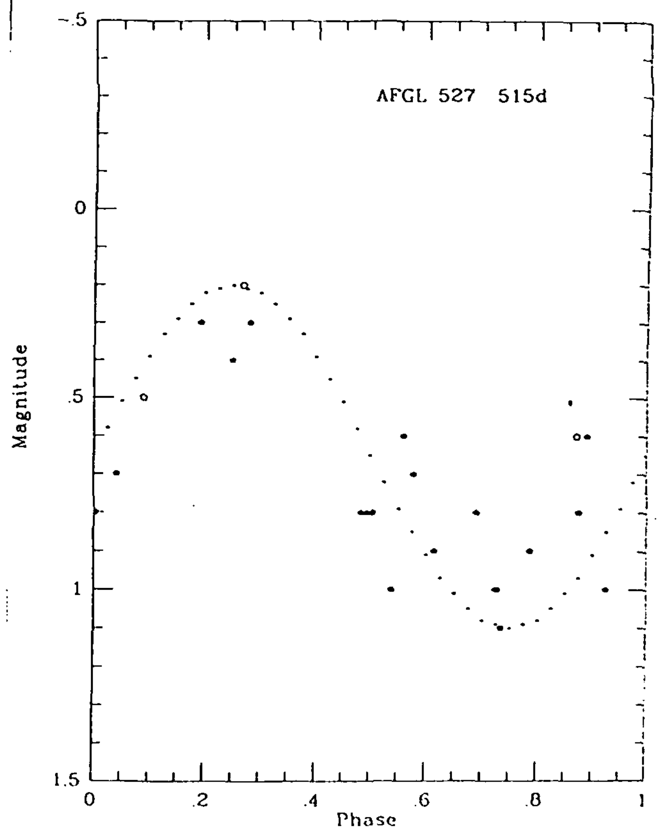
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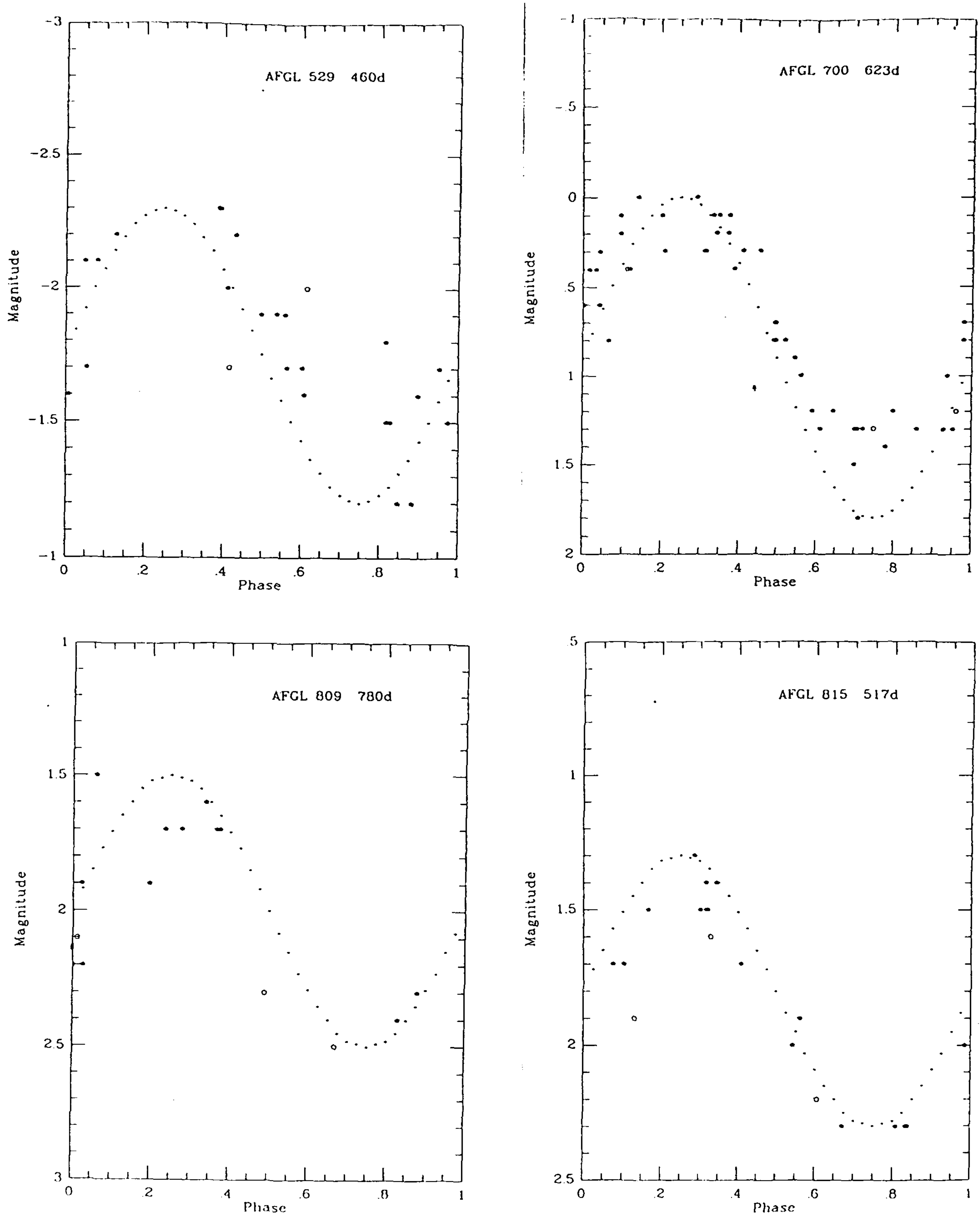
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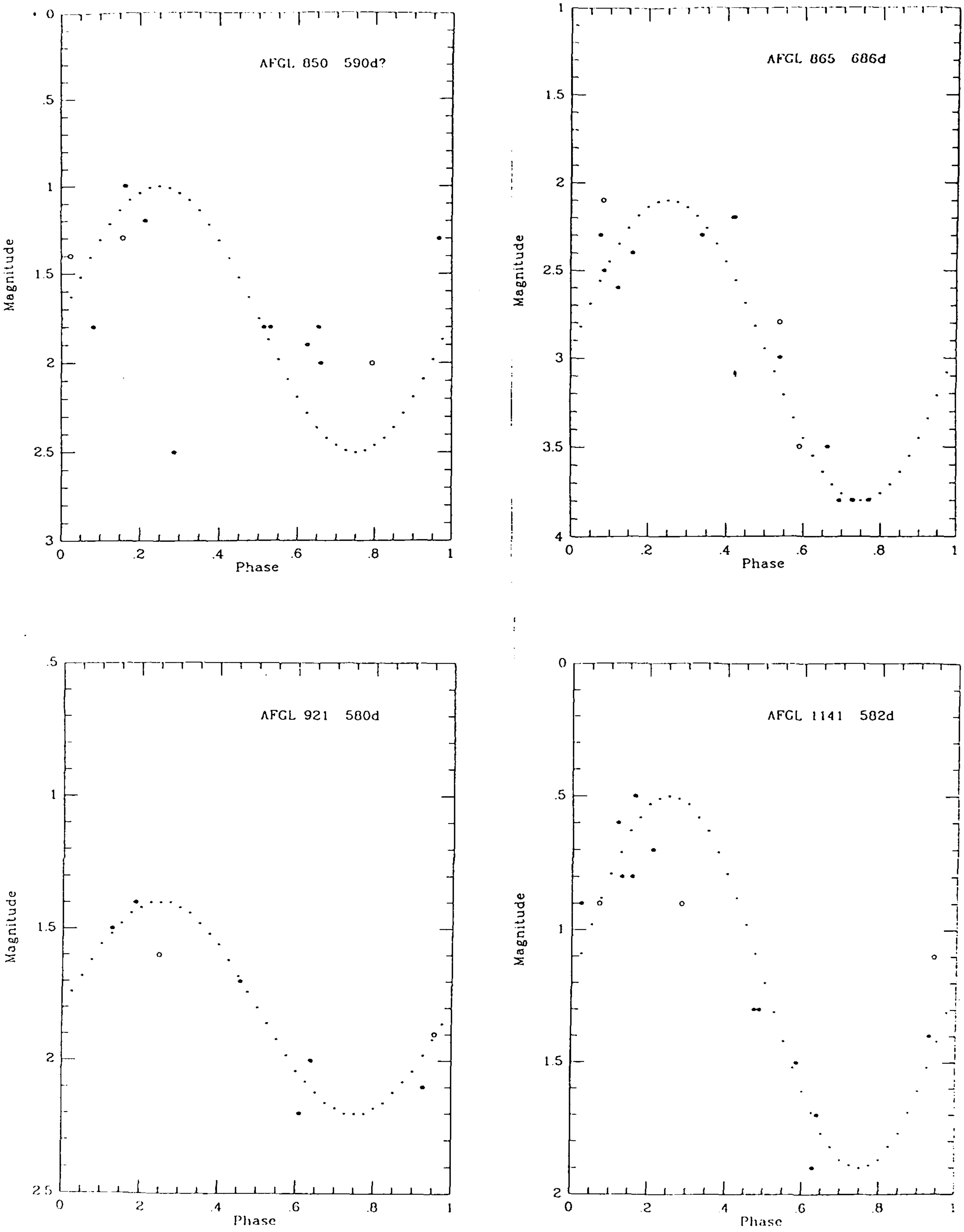
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Phase
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Magnitude
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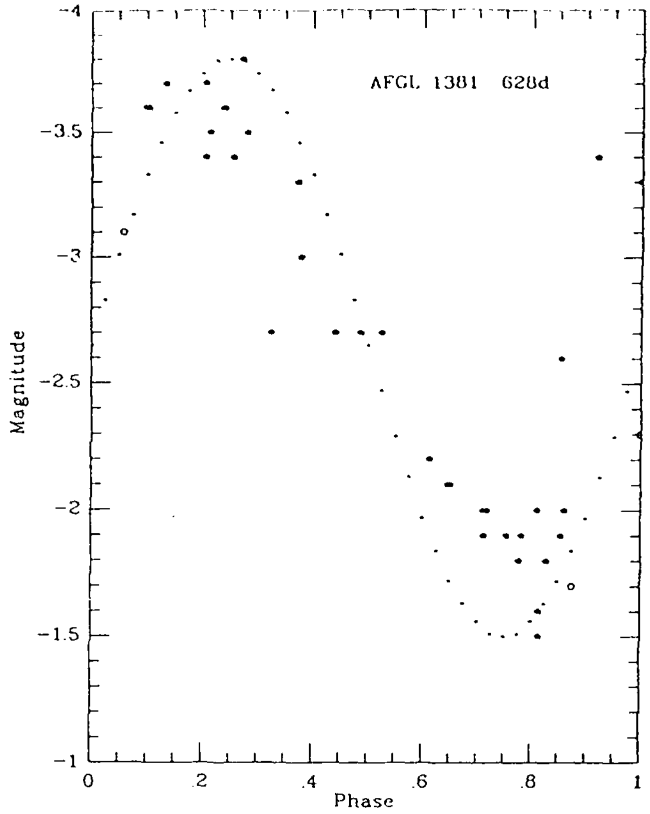
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.6
.8
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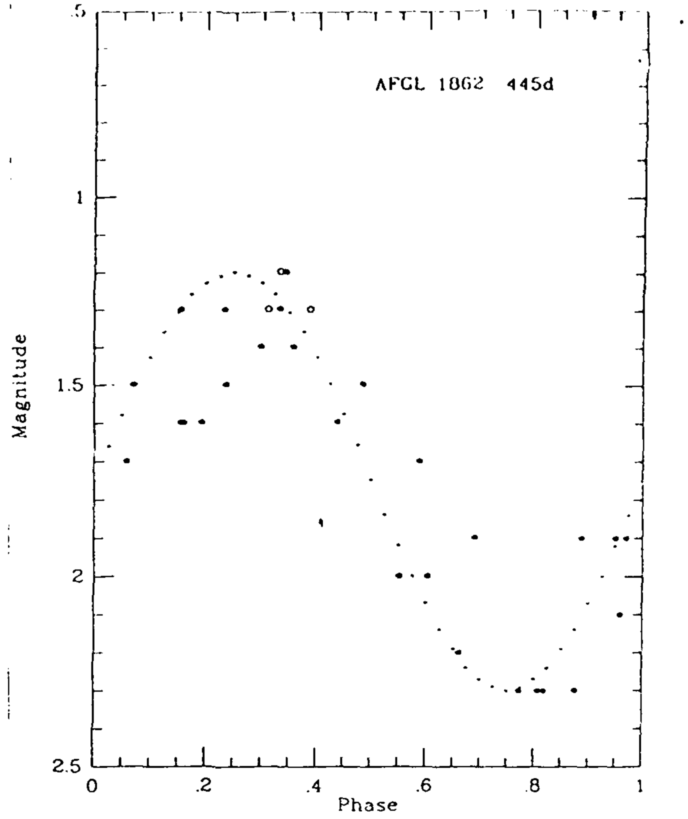
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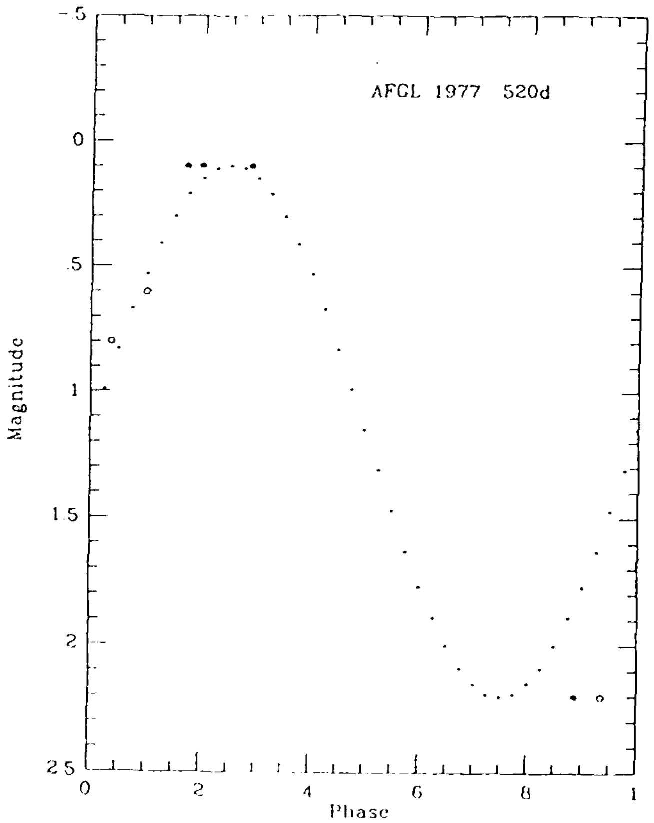
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.6
.8
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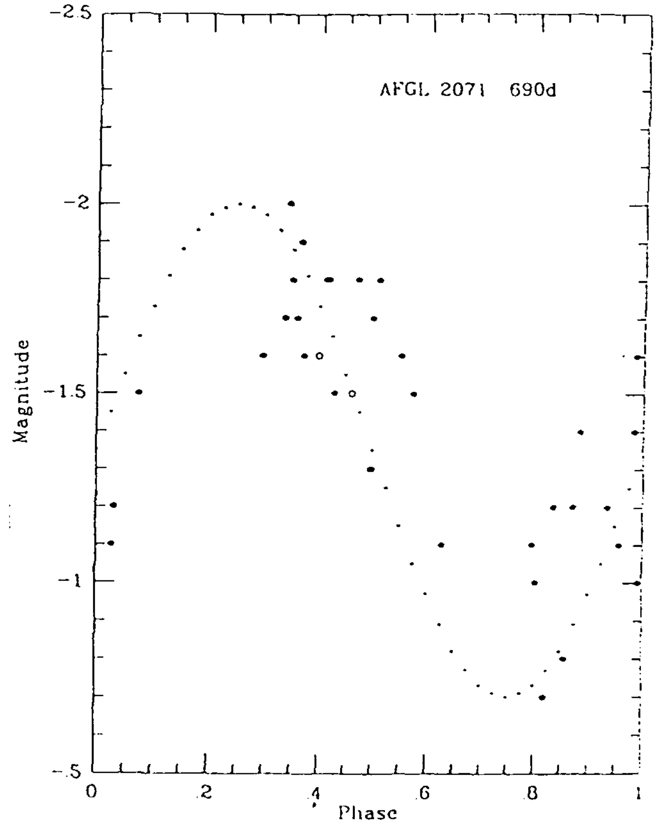
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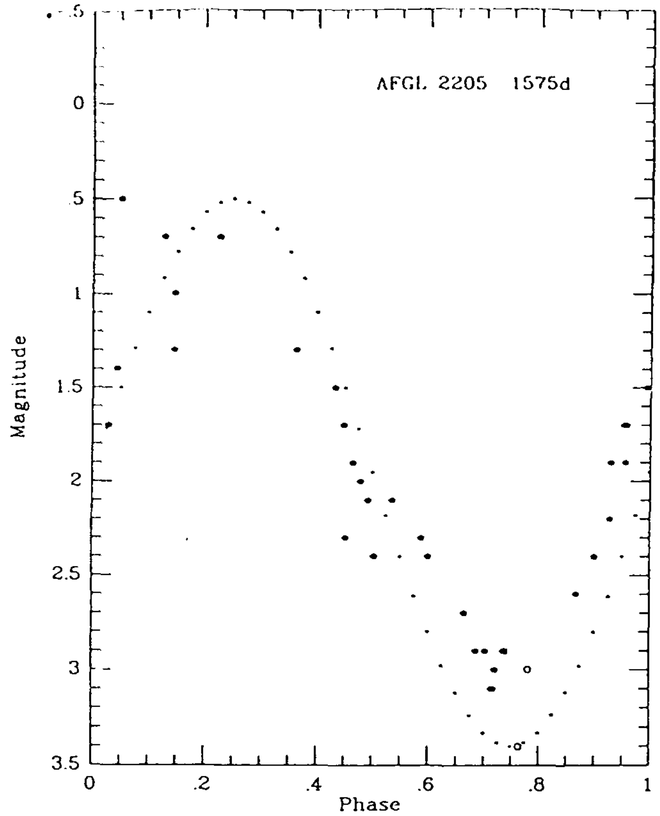
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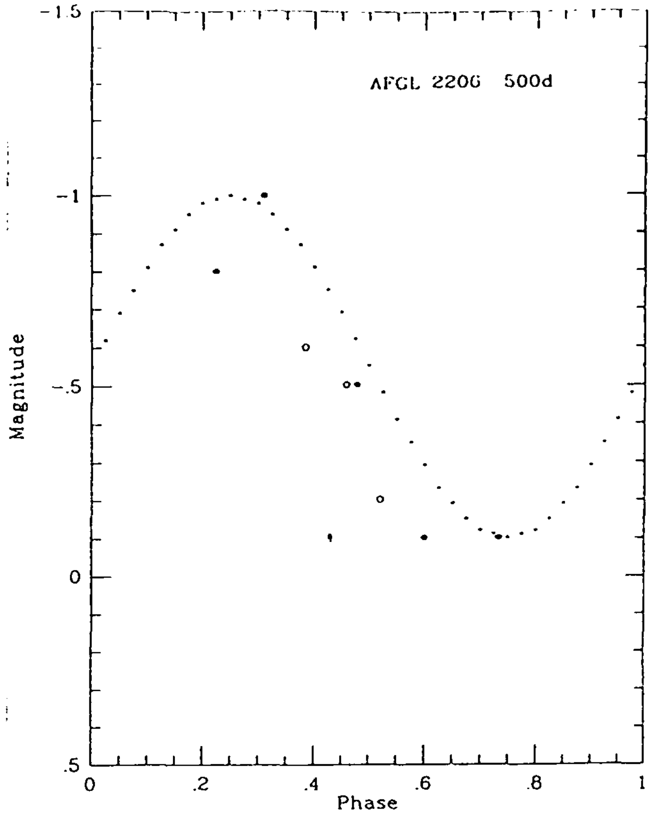
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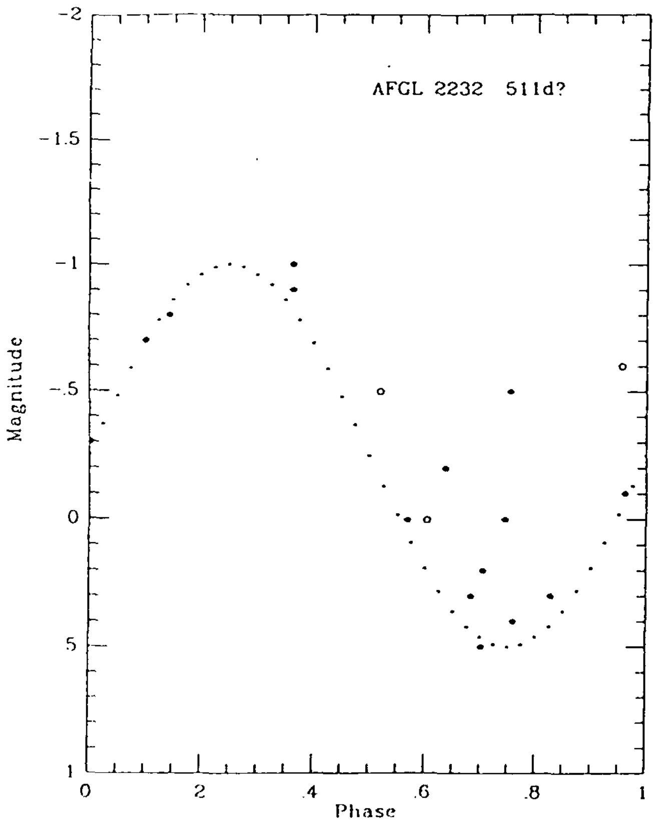
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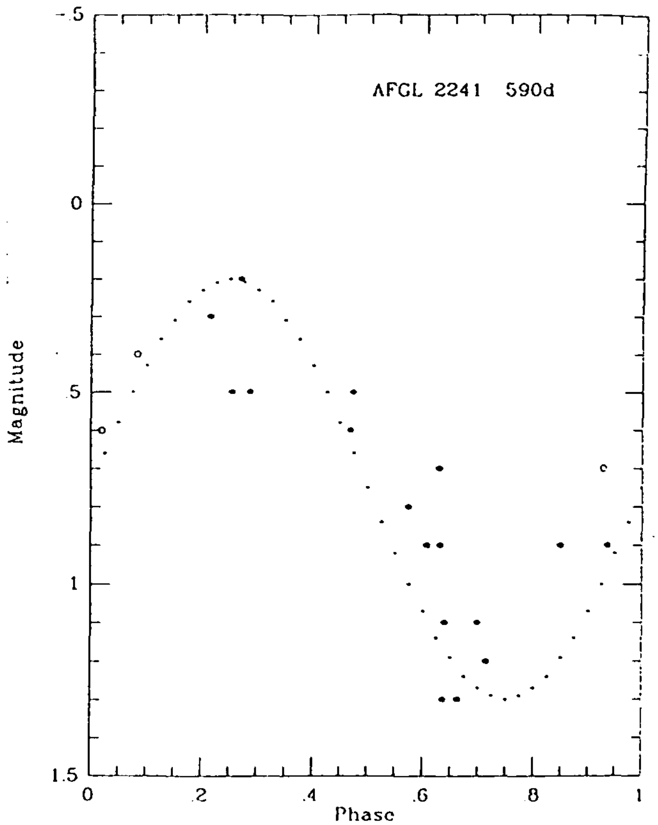
Phase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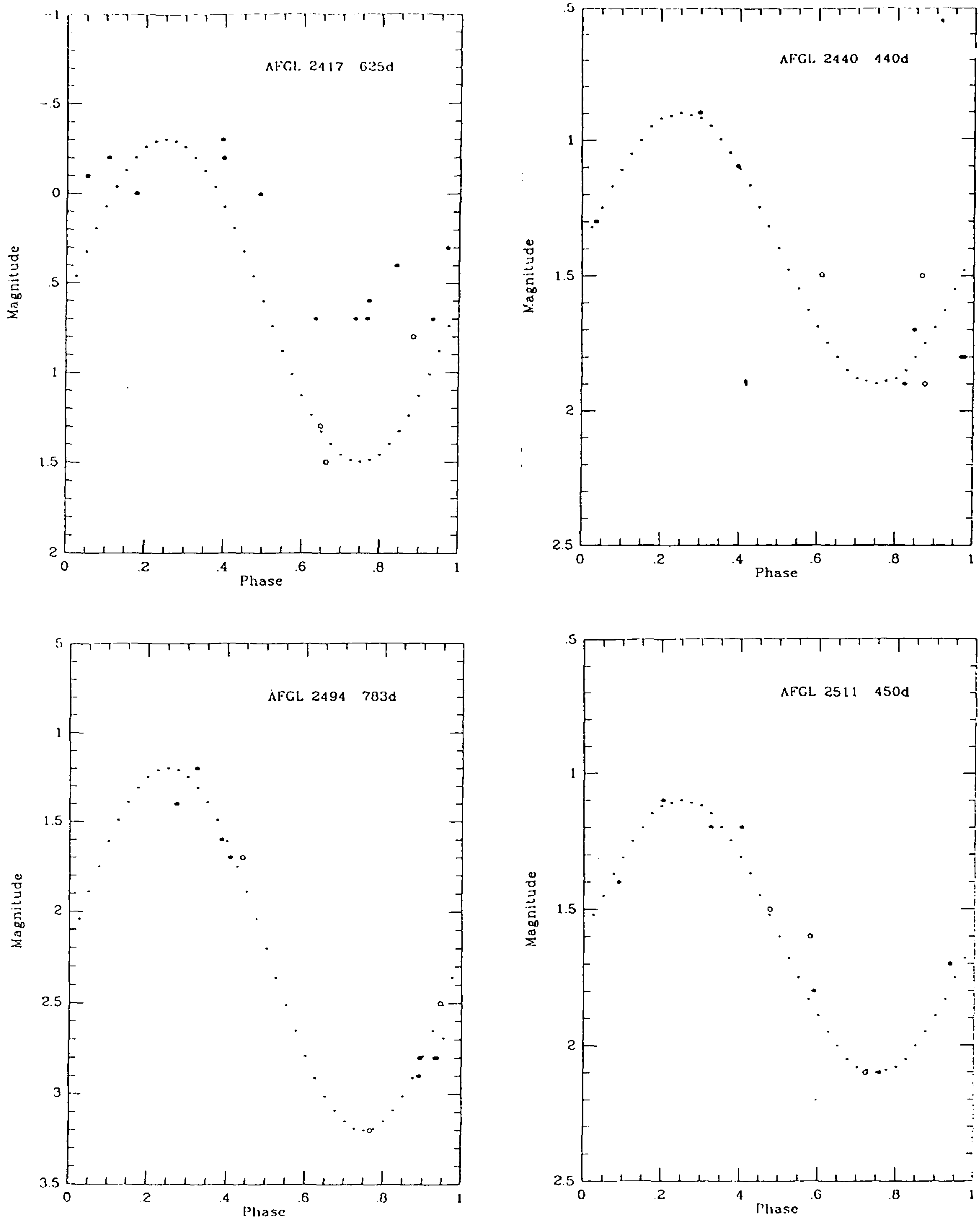
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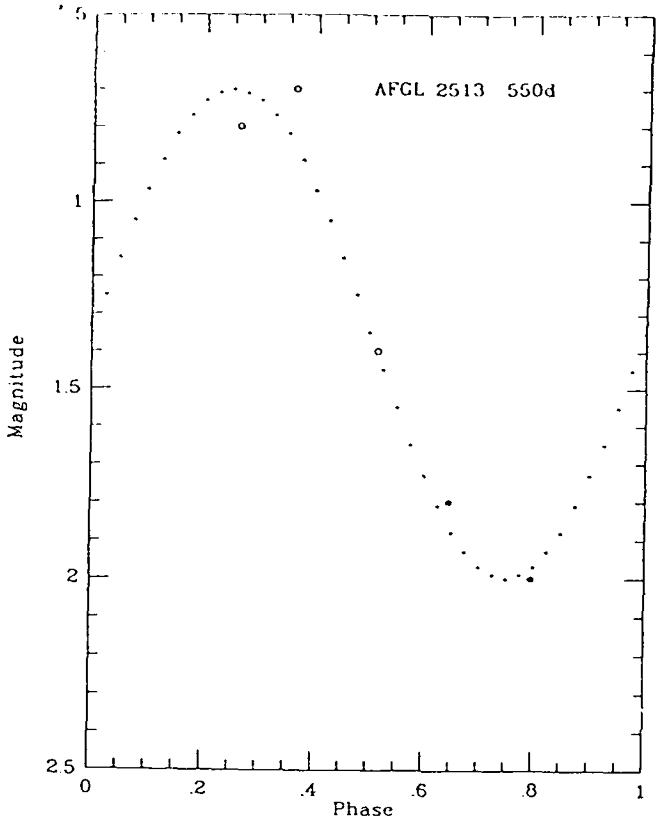
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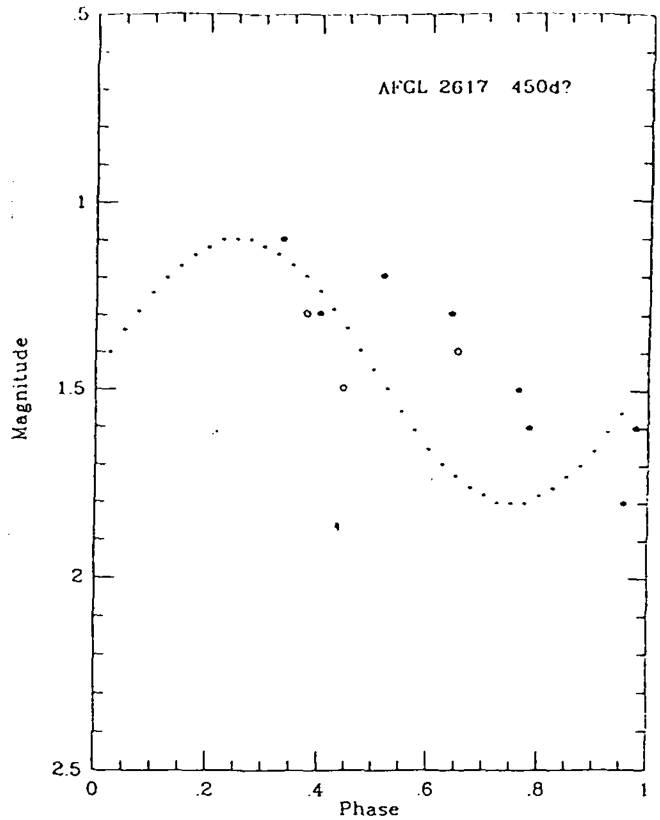
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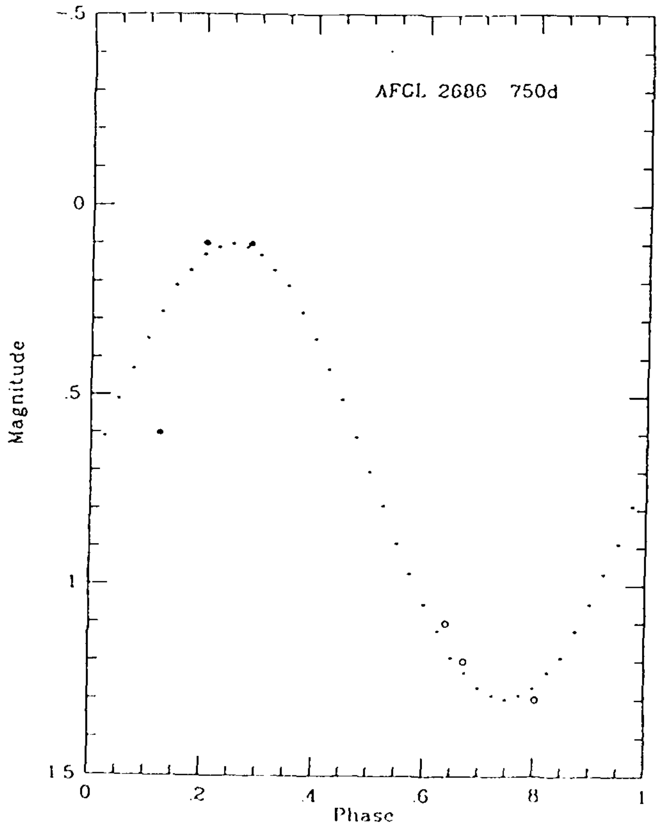
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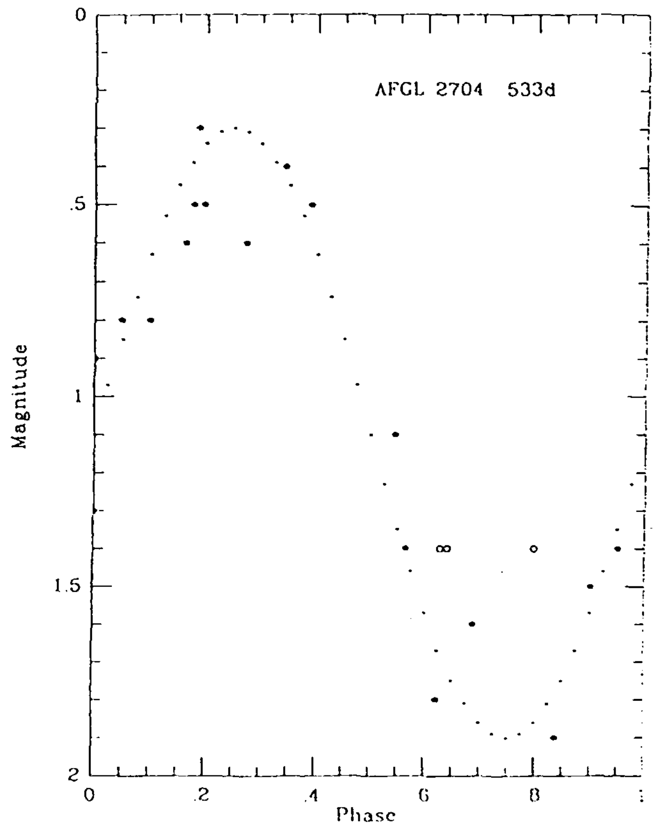
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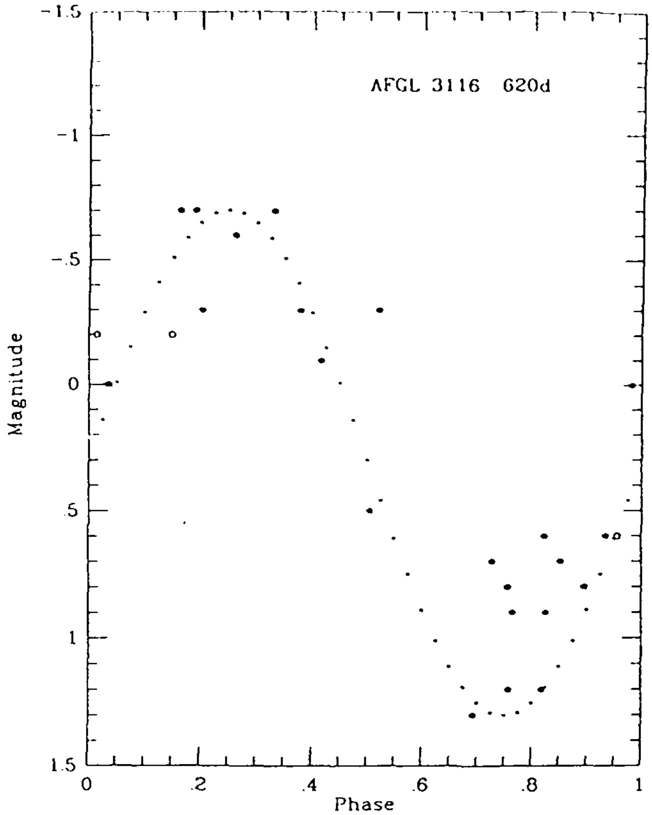
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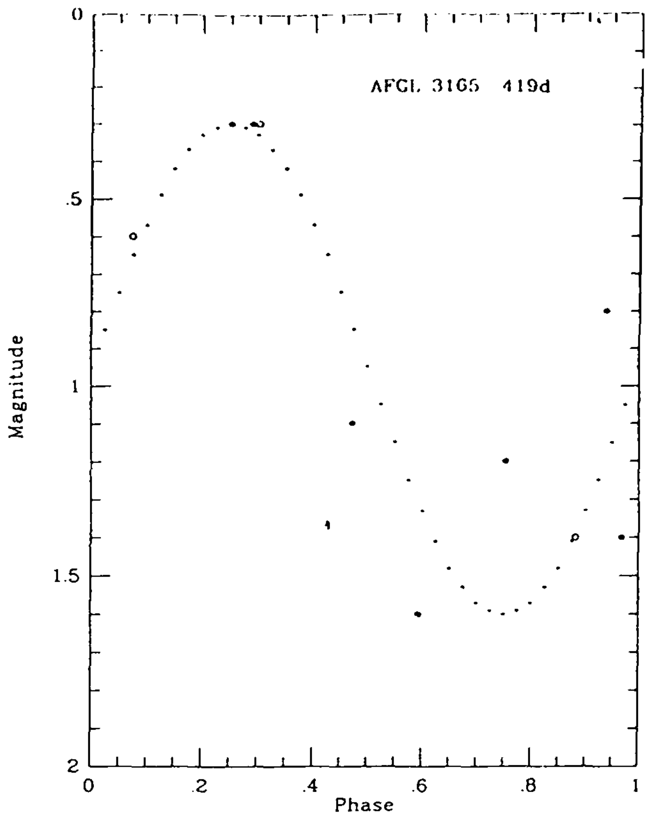
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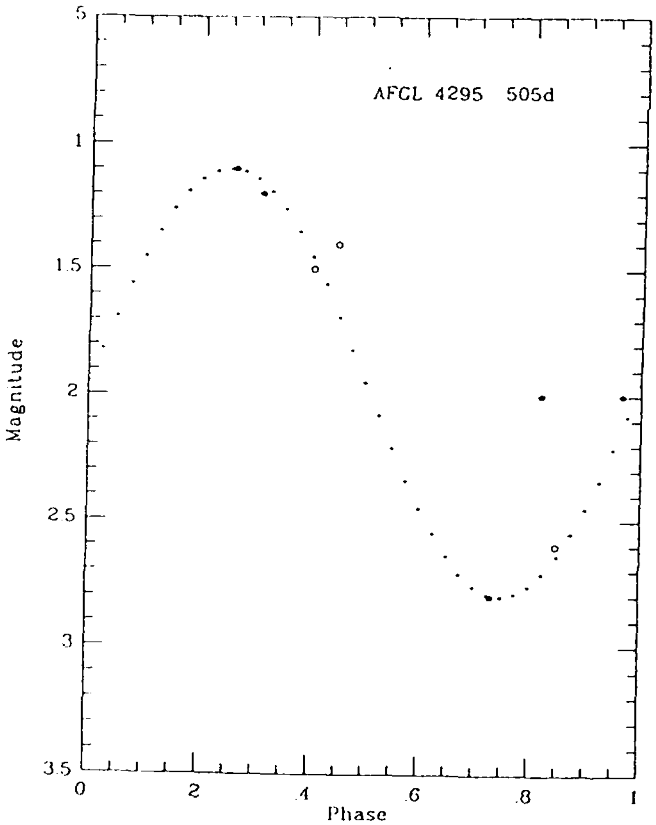
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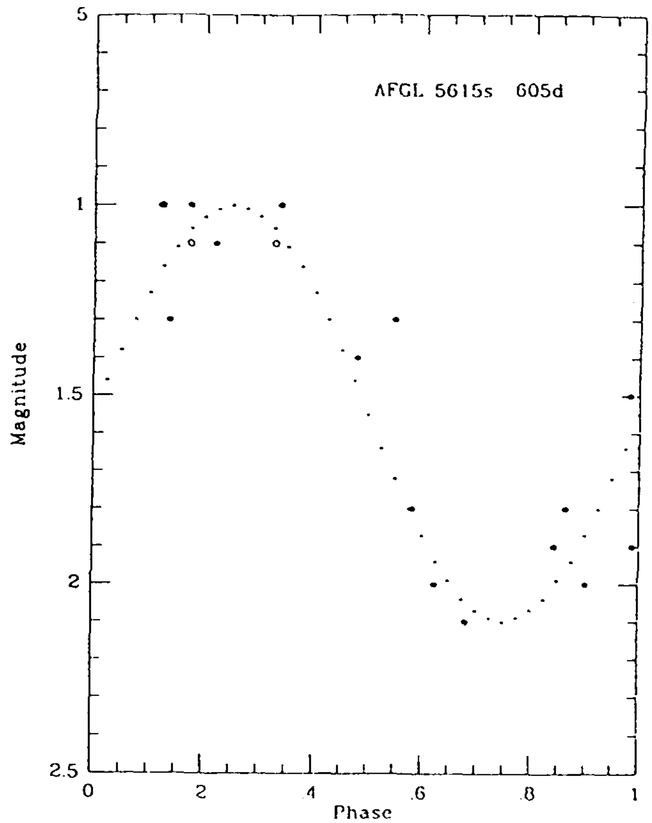
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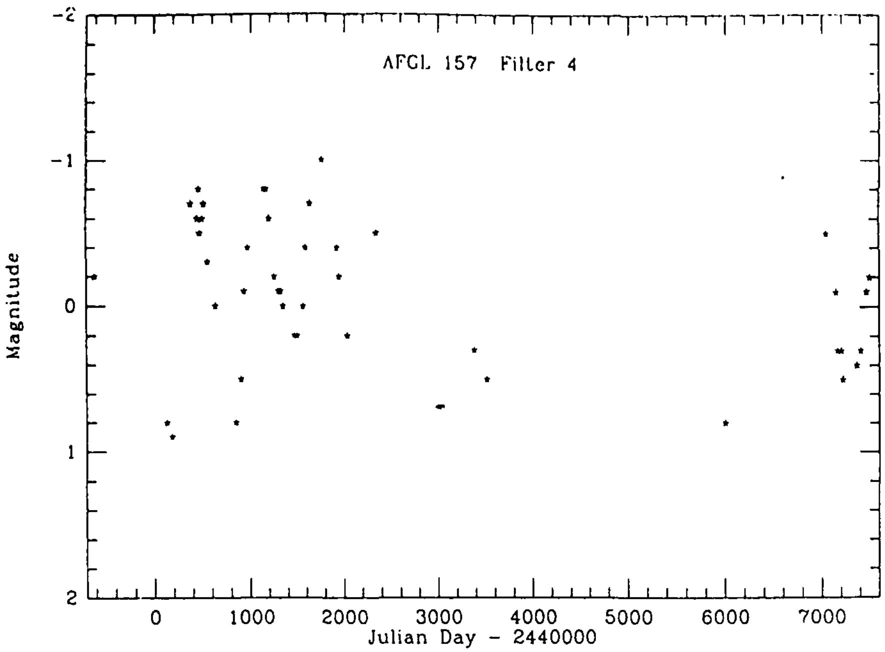
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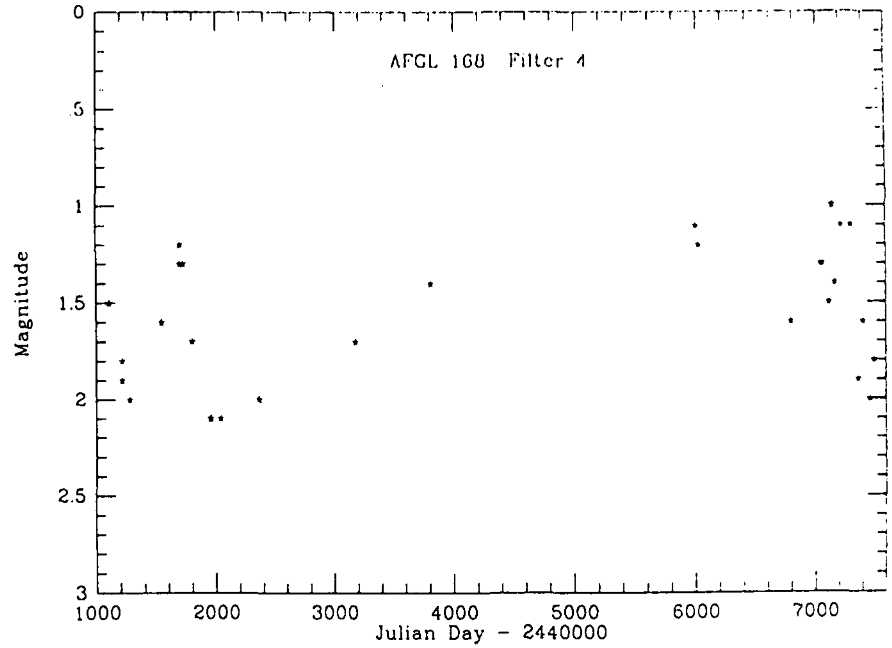
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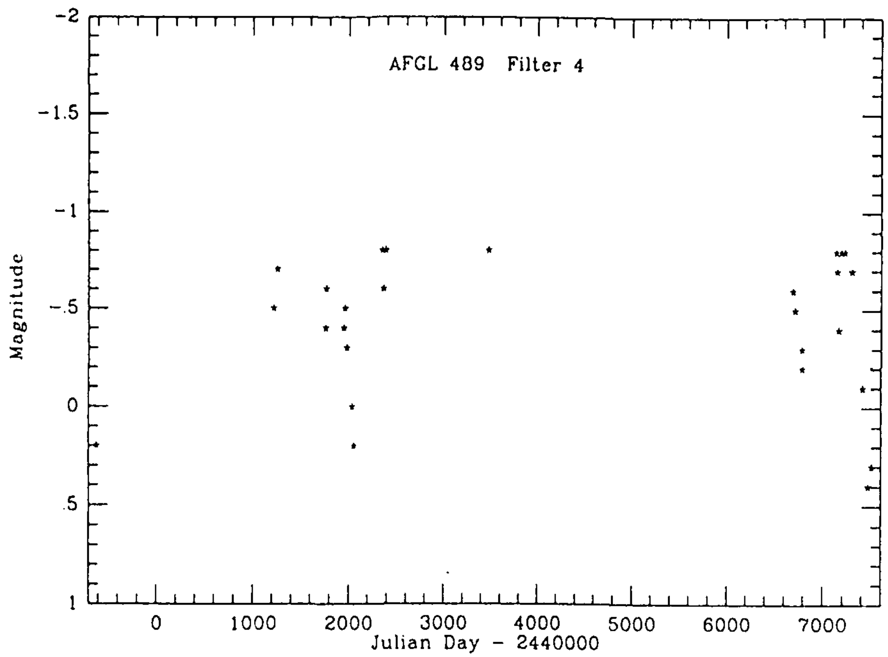
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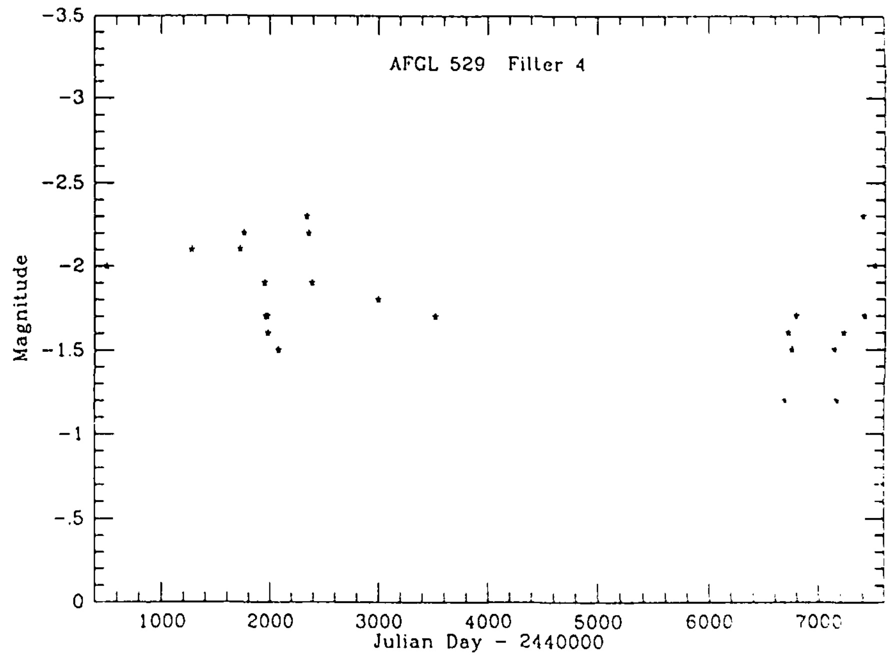
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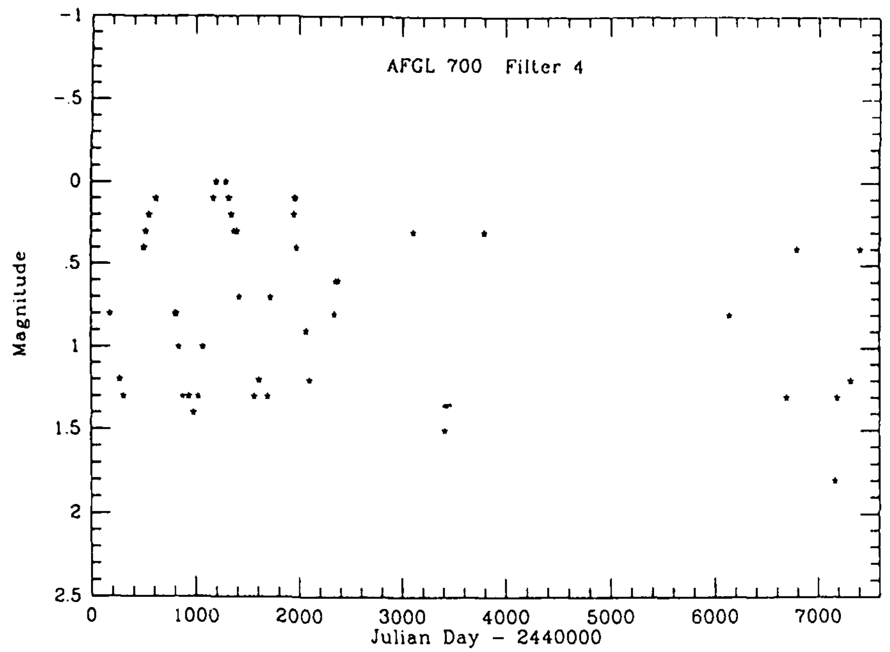
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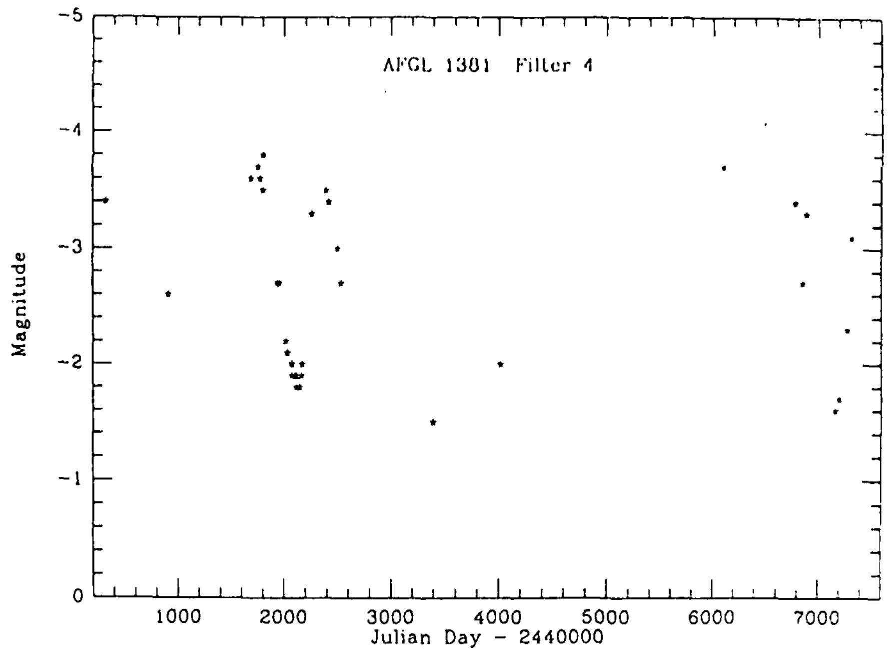
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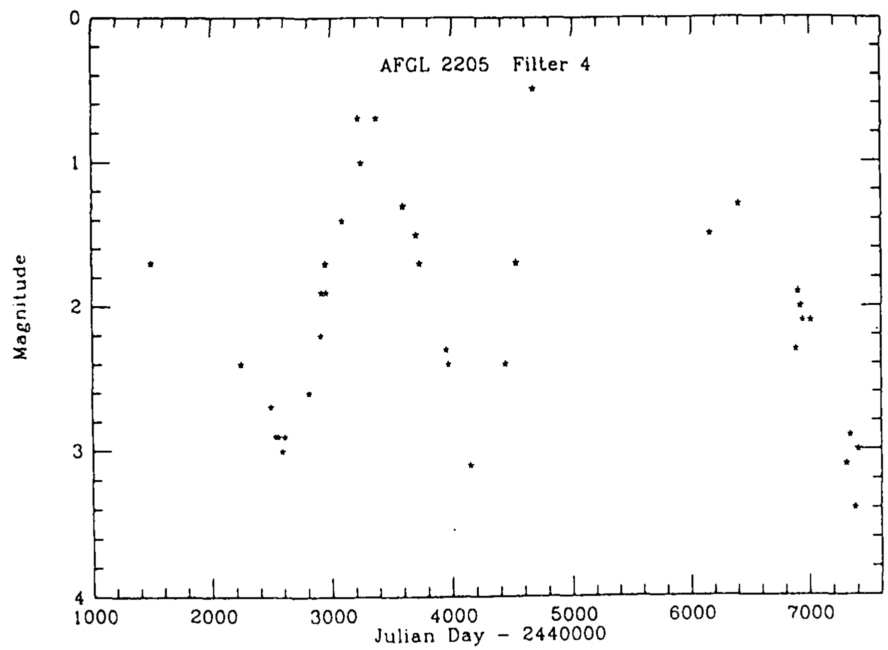
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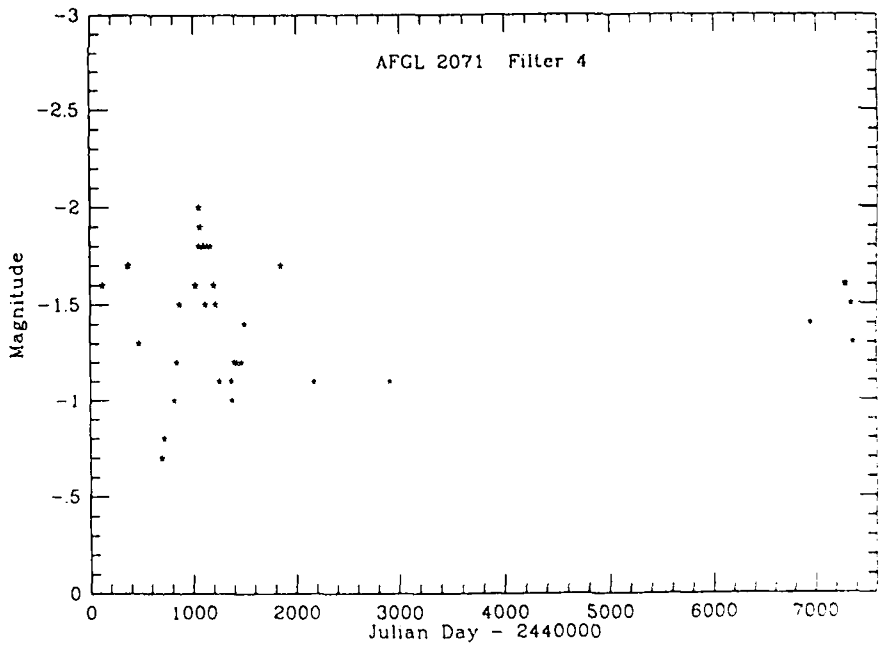
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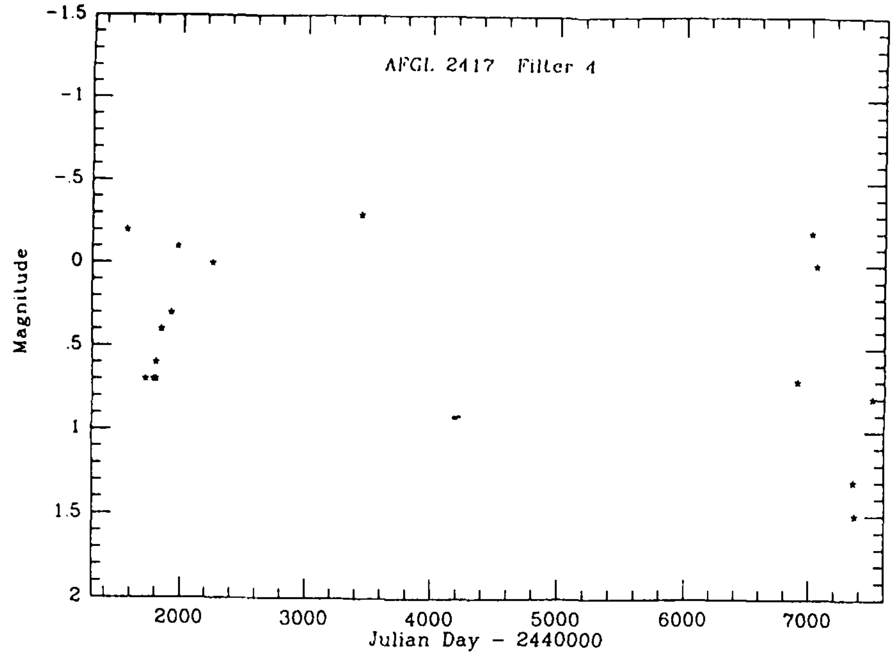
2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.5
1
1.5
2
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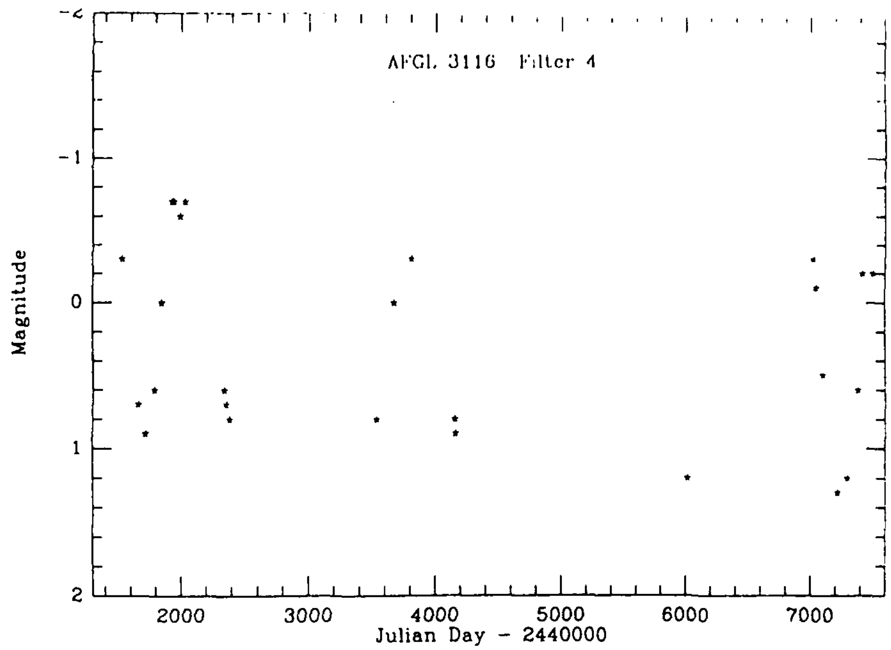
3000
4000
5000
6000
7000
Julian Day - 2440000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7000
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2

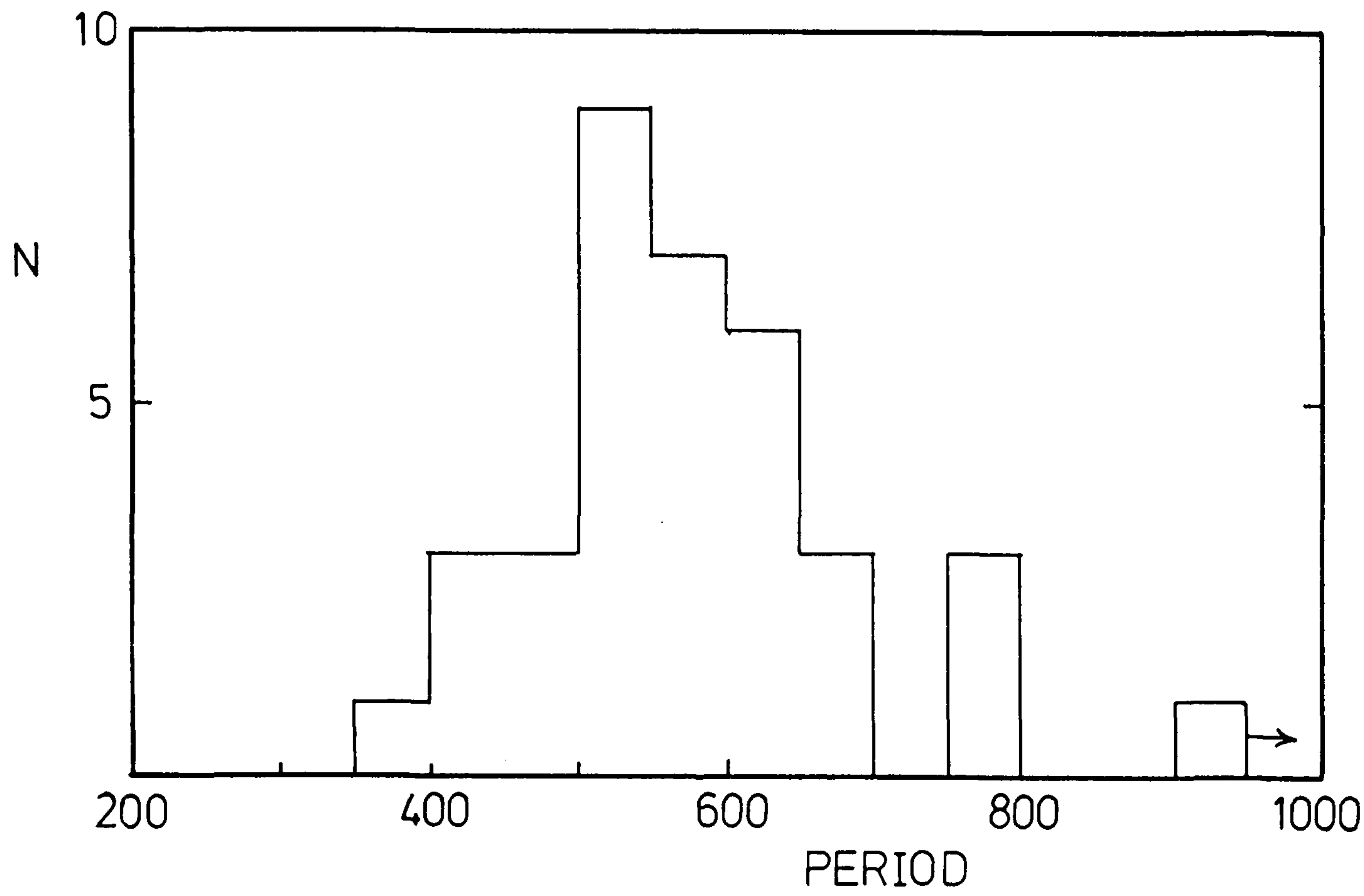

Fig 3

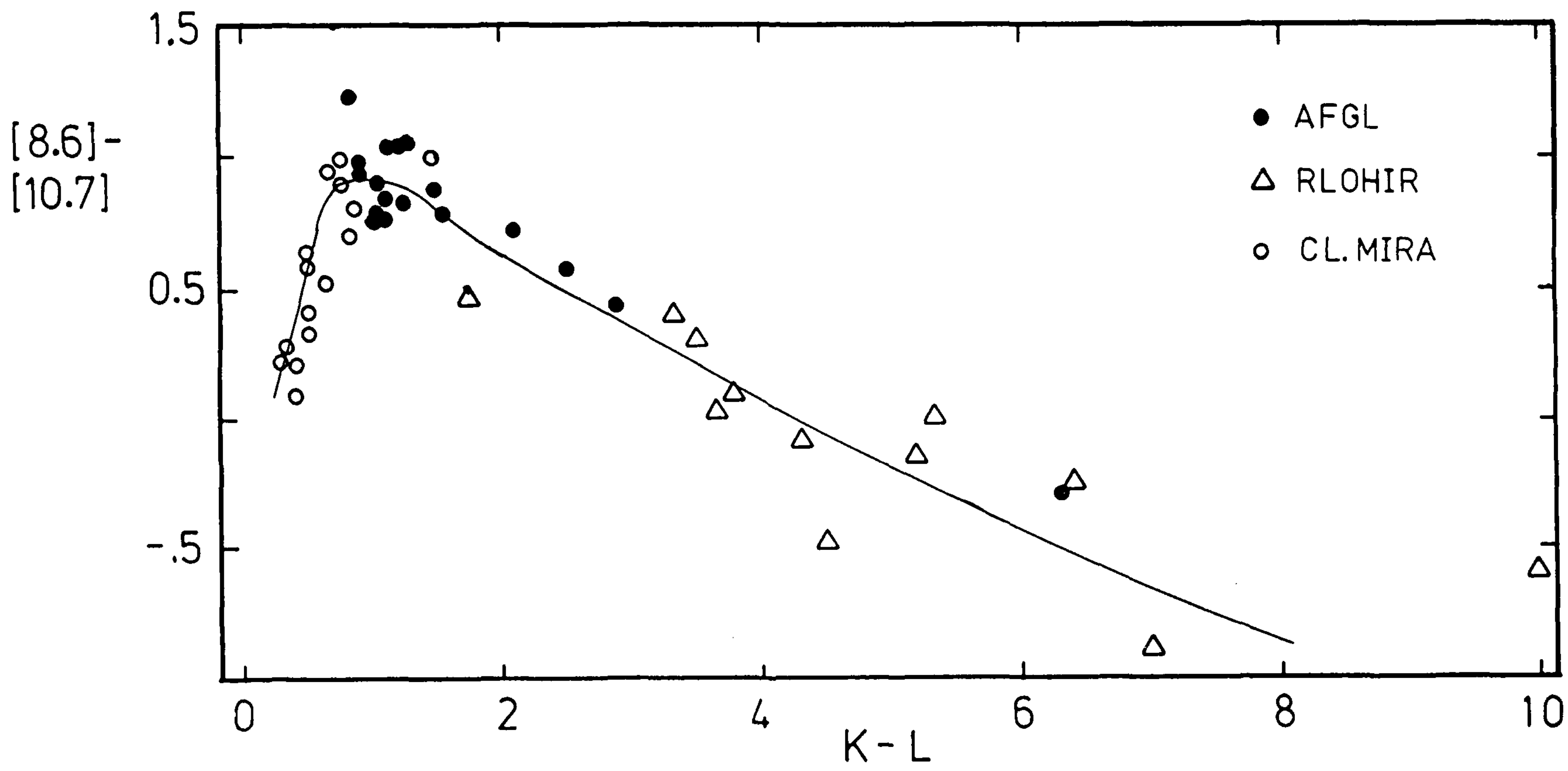

Fig 2c

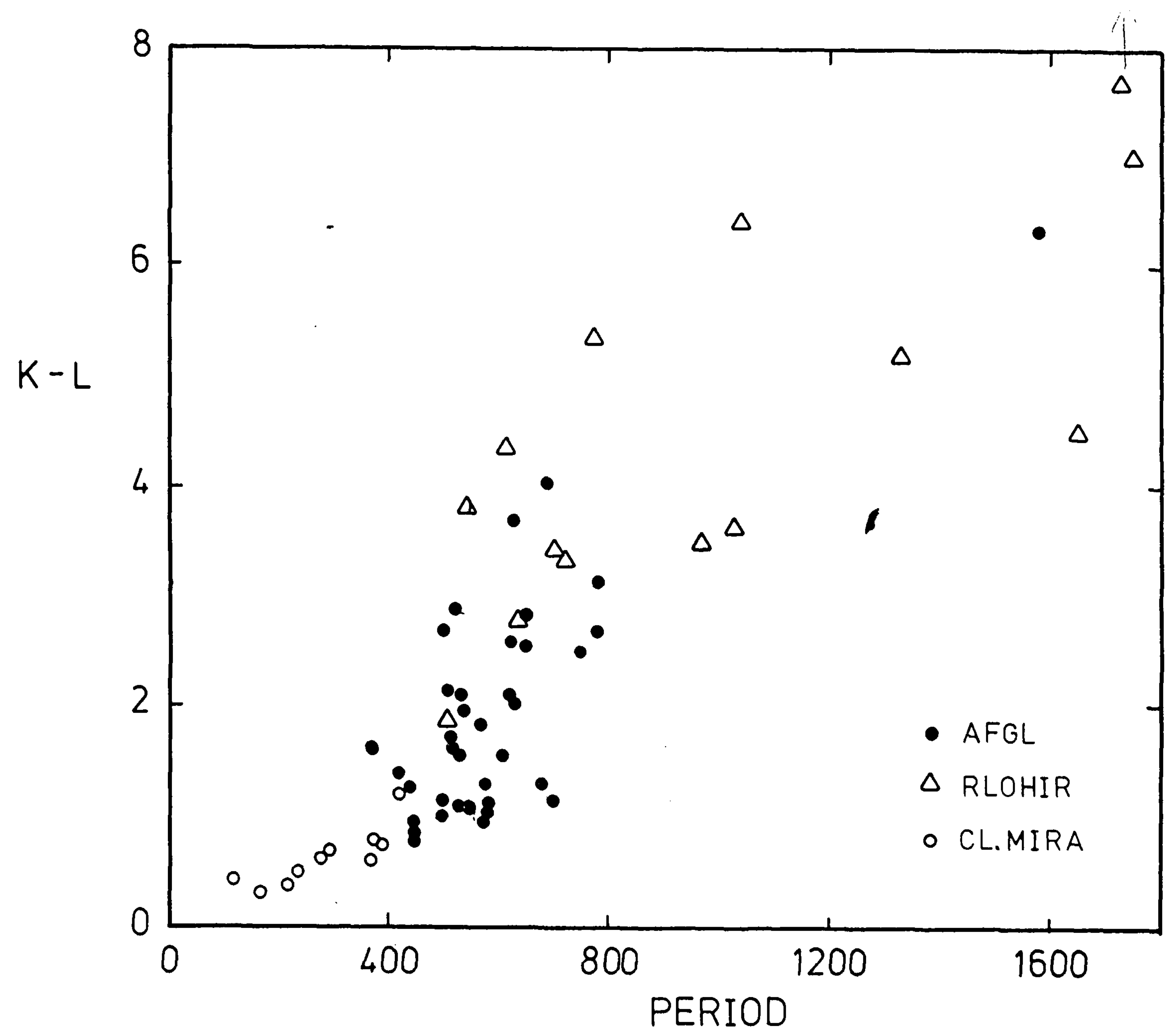

Fig 5

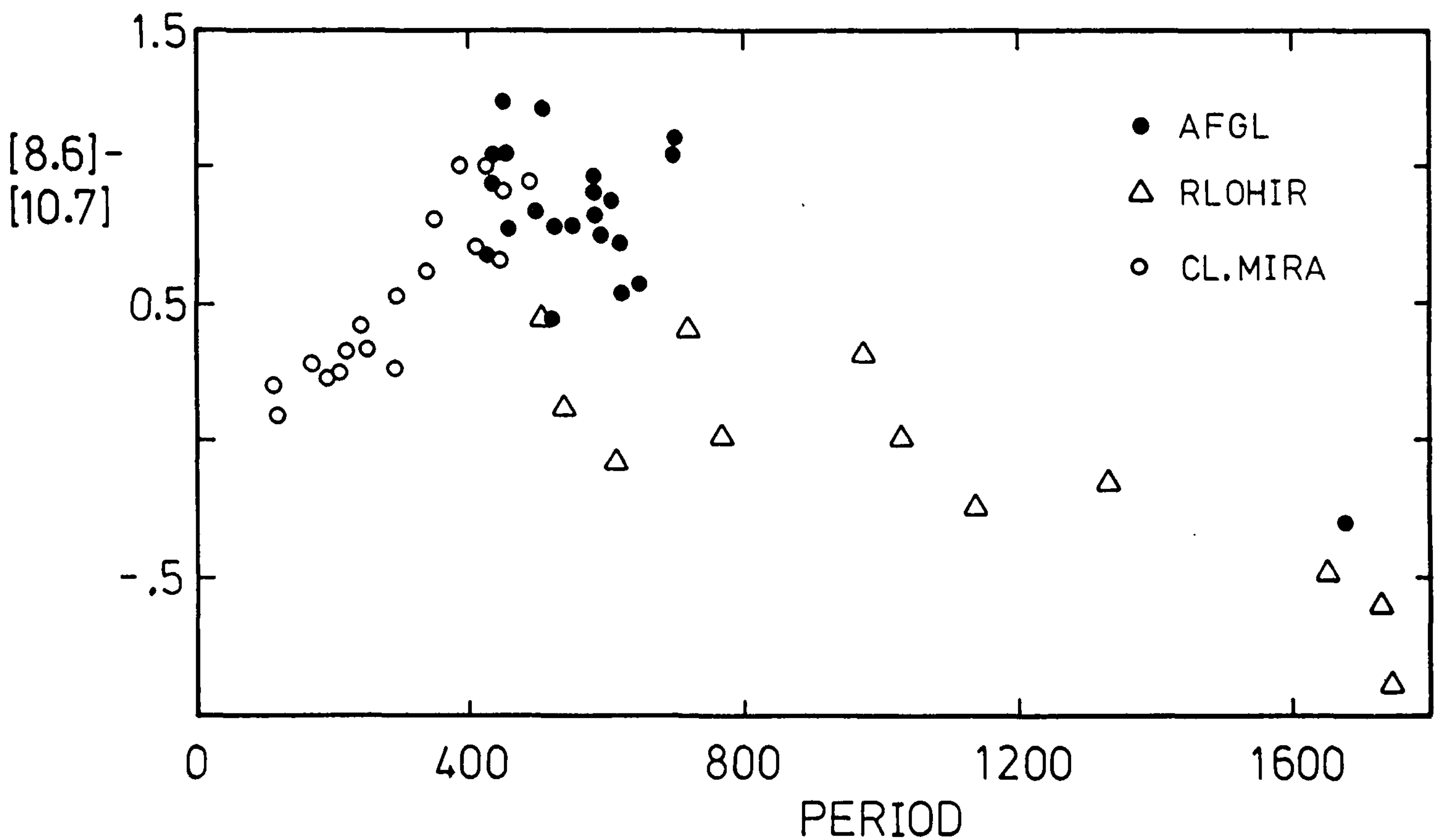

Fig 6